MAIN CURRENTS

IN MODERN THOUGHT

If we want world peace, we must be intellectually equal to the materials of the times. Mankind must speak a universal language of ideas. To do this, we need a common conceptual knowledge through which all may share in cultural advances of the West and cultural heritage of the East and of antiquity. When men understand in common the orders and meanings of the planet and universe which are their home, they can start to achieve a common peace; for peace rests on understanding and conflict rests on ignorance. This is the social message of the Foundation.

Integrative thinking and education are in no way opposed to specialization but instead supply a supplement and a corrective. The worth of a diamond is not to be found in its facets alone. Cutting its surface discloses its brilliance; but the beauty is in the diamond itself, and the way in which it may best be cut to reveal its loveliness in light is determined by our knowledge of its internal order. Specialties help man to see the natural and human world in all aspects more clearly; integration can help him see it whole and use its latent order to noblest ends.

. . . concluding paragraphs of "The Social Meaning of the Foundation for Integrated Education," See pages 99 - 101.

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"Ah, but a man's reach should exceed his grasp, or what's a heaven for?" — BROWNING

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AIMS OF THE FOUNDATION FOR INTEGRATED EDUCATION

The Foundation is incorporated under the laws of the State of New York as a non-profit educational organization. Contributions are tax deductible.

The corporate statement of Aims declares that the Foundation has been established:

1. To collect, create, and distribute authoritative materials which will encourage the development of unified overall concepts in education; to improve the balance of relationships between the physical sciences and the social sciences; to inquire into the phenomena of purposive activity in nature, man and the universe.

2. To assist teachers to understand and use such materials, and to develop an active, realistic, comprehensive philosophy which will communicate to their students the unity, coherence, and beauty of the world in which we live.

3. To remedy, solely by such educative measures, the conceptual and hence the ethical, social, economic, and political breakdown of our times, looking to a peaceful world order.

The members, associates, and staff of the Foundation realize that the progressive discovery of unifying over-all concepts concerning man and the universe is not a task to be performed successfully in isolation from the historical, social, economic, and political context of our times, nor in terms of application less than global.

The work of the Foundation is wholly educational, yet is referred constantly to the contemporary scene in all its aspects, no less than to the total available wealth of human experience and knowledge.

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THE SOCIAL MEANING OF THE FOUNDATION FOR INTEGRATED EDUCATION

Counter Measures to the Hundred Different Directions In Which Specialization Is Leading Us

The great advances in human knowledge and technology during the past hundred years have undoubtedly come as a result of specialization. By concentrating their efforts on separate aspects of knowledge, scholars and technical men of our society have solved countless problems and produced achievements never before dreamed of. Yet, the very specialization which has been their strength has brought problems of its own. The specialties move further and further apart. Even the specialist himself tends to become isolated from his fellows; only his colleagues understand what he says and, if he is a pioneering genius, he may arrive at a frontier which however exciting is a lonely one. Knowledge which should be a continuum branches into discrete divisions. Led by specialties and subspecialties in a hundred different directions, the whole age is confused.

Man has discovered atomic power. This triumph made available for human use energy that had been hidden in the atom through all the milleniums of the past. It showed that specialists in disparate disciplines — physicists, chemists, mathematicians, engineers — could work unitedly toward a challenging goal. They achieved a common vision, learned new concepts and terms, formulated bold hypotheses, laboriously and courageously tested and proved them. They gave man a new power that may enrich or annihilate humanity. It is obvious that, if he is to survive, man must prove himself morally and spiritually worthy of the trust. Is it not reasonable to suppose that man, who has succeeded so tremendously in mastering physical law, can discover and utilize laws inherent in his own psychological and social nature to an extent equal to his need?

Amidst the confusion of numerous disciplines, the current demand seems to be for some sort of vital admixture of order. The centrifugal forces of analysis, dissection, and differentiation require centripetal forces of synthesis, organization, and unity to balance them. Scholars and thinkers in all walks of life, disturbed about the effects of specialization, have begun to search for the unity whose importance becomes increasingly evident. The solution is an integration of knowledge which displays a rational order underlying the apparent disorder of the many specialized disciplines. This movement toward an integration of knowledge in research and teaching has begun in education.

The Foundation for Integrated Education

The Foundation for Integrated Education is part of this movement. It is an organization devoted to the study of knowledge and teaching. Its activities are restricted to education; and, within this area, they are concentrated on the search for a unity in knowledge which will give mankind new insights into the orders of nature and into man's place in those orders.

From the startling materialistic advances during the past 100 years has arisen in the minds of men a variety of unfortunate dichotomies. Science has become alien to religion, the West hostile to the East, contemporary wisdom contrary to that of antiquity. The Foundation leaders question the validity of such dichotomies. They believe that further study will reveal mutualities rather than antipathies. In a concrete sense, since peace, like war, begins in the minds and hearts of men, there is need to welcome and understand knowledge which seeks to integrate rather than to separate all aspects of our culture and other cultures. The Foundation directs studies to a concord among free men possible in a world liberated by technology and science from the cruder limitations of its bondage to physical or animal necessities. The Foundation seeks to ensure that the material advances of the recent past should not be devoted only to the making of better weapons, but to creating better communication between individual and nation, that such weapons may ultimately cease to be needed.

The program of the Foundation rests on the assumption that all knowledge — that of the psychological and social aspects of the human being as well as his understanding of the physical and biological order — has a unity and pattern. This unity and pattern has been perceived partially in the physical and biological sciences. But the unity is no less real, although much harder to identify, in the psychological and social sciences and humanities. In the present age the search for such understanding is imperative.

The Foundation is devoted to the development of techniques, concepts, terminology, and an education program for integrated thinking and subject matter. Its workers have sought to discover, for example, whether or not there are methods of research and scholarship which apply to the social sciences and the humanities just as effectively as they do to the physical and biological sciences. They have found that integrative studies reveal more and more of the orderliness of the universe. They have found that an understanding of this orderliness confirms the importance of the individual as the basic, important unit of society traditionally associated with the democratic organization of this nation. This understanding implements the belief in government by law to protect the individual's freedom by an orderliness in society. It opposes personal rule by either a dictator or a small party, both of which would have their special definitions of the truth. The more widely the significance of order is understood and expounded, the more the secular educational systems will convert our democratic ideals of freedom, which were originally based on an intuitive concept of "nature and nature's God," into a documented and teachable natural fact.

The Foundation is concerned especially, as a minimum objective, with the development of an education which will progressively help to insure an American consensus – that is, an understanding of and general knowledge for such understanding of the basic principles on which American democracy has grown. This is close to the purposes of the founders of our country who believed that order and not chaos is fundamental in the universe and that man is, and of right should be, free because freedom is a function of order. While seeking to help develop an integrated education for our own country, the Foundation at the same time seeks one that should have world-wide validity, an international consensus based on a recognition of common cultural elements, as well as common knowledge.

The work of the Foundation has three phases: research, cooperative program, and experimental courses.

Its Research Program

In its research activities, the Foundation is assembling significant existing literature of integrative thinking in order that it may provide information and stimulus to current studies in curriculum development. It investigates the methods and basic concepts of natural science to the end of applying them in the areas of the social sciences and the humanities. It conducts and encourages original projects in research.

Integrative scholars have found the necessity for a common technical language for all disciplines. The Foundation seeks to give widespread understanding of terms and concepts which are ordinarily used only by esoteric specialists but have potentially wider application among different disciplines. Examples of such terms are: perception, induction, epistomology for a common methodology; indeterminacy, symbolic logic, rational parameters, mitosis, homeostasis, evocators, genetics, evolution, and organism from physics and biology; gestaltism, paranormal, and individuation from psychology; and social energies, interaction, role, metalinguistics, and signs from sociology. Many technical terms like these need to become part of a common language for all scholars.

Its Cooperative Program

The Foundation cooperates with colleges and universities by serving as a clearing house for integrated knowledge and education and by helping them to improve their integrative and general education programs. It seeks to keep in touch with and to aid integrative studies and programs of integrated education on university and college campuses. It publishes the periodical, MAIN CURRENTS in Modern Thought, and other material in the field of integrated education.

Its Experimental Courses

The experimental courses have the most significance for the Foundation's social implications. These courses are of two kinds: those devised with and for individual institutions and those organized for adults. The courses in either form are developed to help participants gain a concept of the breadth and unity of man's knowledge. The course leaders seek to give a concrete answer to the most disturbing questions of our time: What minimum of knowledge and understanding do men and women of resolute interest and good-will need if they are to have a common understanding of man and nature sufficient to maintain a free society? How can they as citizens help to advance the general welfare of mankind and of freedom in our complex technological civilization?

The courses bring to participants great thinkers of our day who discuss the subjects with which they are most concerned, not as special areas of knowledge but as significant aspects of a unified and not yet clearly discernible whole of understanding. These scholars seek to bring man, his world, and his universe into an integrated perspective. To do this, they teach from the following considerations:

1. Students, of necessity, have quite different educational backgrounds and thus must be brought to a common information and understanding level. This equalizing is accomplished by bringing the students up to the present frontiers of knowledge – not by means of a complete study of the data and theories of each discipline but by making clear the accepted and the contemplated theories which make sense out of the data and information in each field. Then, in each subsequent year that the course is given, the teachers push a little

further into these frontiers of knowledge, to make clearer the possibilities of a greater integration and to show the implications for the future. From such a course, the students obtain some grasp of pioneering efforts in all the important disciplines of our generation.

2. The courses also seek to develop an adequate understanding of the process of knowing itself so that students will comprehend what is valid learning. Thus, the courses involve consideration of both the scientific and philosophical methods for gaining insight into factual data. This, in turn, makes clear that not all disciplines have developed methodology for handling their knowledge to the same degree of effectiveness. It also suggests that the methods of one discipline may be used to aid the scholars of another. It presents the possibility of gaining a unity for understanding by means of a common methodology for such areas as art, religion, sport, and ethics as well as physics, chemistry, biology, sociology, history, and the more fully developed studies.

The second consideration above makes clear that the Foundation, in these courses as well as in its over-all program, encourages inquiry into the frontiers of the knowledge of the total system of which man (in his own eyes at least) is the central part. It is hoped that the courses will provide participants with a sense of proportion concerning the nature of man, his origins, and his function in this nation, on this planet, and in the cosmos. In other words, out of the integration of the various disciplines by the aid of which man probes himself, his environment, and his beliefs, the participant in the course begins to glimpse something of the awe-inspiring unity of the universe and the meaning of existence in its fullest sense. The mind of man journeys beyond the boundaries of even his own universe, although he be chained, like Prometheus, to the earth and his vitals be torn by the needs and desires of a body and a psyche.

The Future of Mankind

From this sort of inquiry, the effort of the Foundation assumes great significance to all who look to a greater and greater future for mankind. What the Foundation seeks is to preserve and enhance the revolutionary advances of the sciences during the past few centuries and especially the past 50 years. Future advances of incalculable benefit to mankind are threatened by the current turmoil and confusion. Out of the welter of esoteric and disturbing discoveries and theories must come some sense of purpose and direction or man, in a wild negative thrust, will throw out all that he has gained. The current "revolt against intellectualism," as it is called, provides most immediate evidence of this grave danger.

In conclusion, then, it becomes clear that the Foundation seeks to advance the cause of understanding in several directions. It desires to open up to all an understanding of the frontiers of knowledge in all disciplines; it envisages an eventual understanding of the meaningfulness and unity of the whole of knowledge in this and other cultures; and it works toward the development of a common language which will enable scholars to communicate not only with each other but with knowledgeable people everywhere.

If we want world peace, we must be intellectually equal to the materials of the times. Mankind must speak a universal language of ideas. To do this, we need a common conceptual knowledge through which all may share in cultural advances of the West and cultural heritage of the East and of antiquity. When men understand in common the orders and meanings of the planet and universe which are their home, they can start to achieve a common peace; for peace rests on understanding and conflict rests on ignorance. This is the social message of the Foundation.

Integrative thinking and education are in no way opposed to specialization but instead supply a supplement and a corrective. The worth of a diamond is not to be found in its facets alone. Cutting its surface discloses its brilliance; but the beauty is in the diamond itself, and the way in which it may best be cut to reveal its loveliness in light is determined by our knowledge of its internal order. Specialties help man to see the natural and human world in all aspects more clearly; integration can help him see it whole and use its latent order to noblest ends.

"A philosophy which could claim the adherence of social physicists, social engineers, and operations analysts alike might run as follows: Right thinking and right action are always valuable, but mortal man never attains to perfect absolute ethics, nor absolute truth, nor even to absolute logic. As we gain command of wider reaches of sciences, our ethics can become more consistent and elegant, but neither attainable science nor attainable ethics is ever a complete substitute for the why. Yet as an article of faith some among us may postulate that at the level of perfection, toward which forever we strive, the three — ethics, science, and logic — become one and the same."

—J. Q. Stewart "A Basis for Social Physics," *Impact,* Vol. IV, No. 2, Summer, 1952.

SOME METHODOLOGICAL SIMILARITIES IN MODERN PHYSICS AND ECONOMICS

Charles B. Friday

Oregon State College

Common Elements in Two Disciplines Establish a Basis for a Dynamic Theory

I

Modern scientists are becoming increasingly aware of the need of better understanding the relationships between the disciplines of knowledge. That there are no clearly demarked boundary lines becomes more and more a certainty as pioneering thinkers push further into mathematics, the physical and biological sciences, and into some of the more complex relationships of economics, political science, and the other social sciences. Max Planck, the noted German mathematical physicist, expressed this relationship clearly:

> "Looked at correctly science is a self-contained unity; it is divided into various branches, but this division has no natural foundation and is due simply to the limitations of the human mind which compel us to adopt a division of labor. Actually there is a continuous chain from physics and chemistry to biology and anthropology and thence to the social and intellectual sciences; a chain which cannot be broken at any point save capriciously. Again the methods used in the various branches are found, if closely considered, to have strong inner resemblance, and if they appear to differ it is only because they have to be adapted to different subjects which they treat. This inner resemblance has become more and more evident in recent time, to the great advantage of the whole of science."[1]

In line with the viewpoint expressed by Planck and others, the author has examined the methodology of physics and economics to attempt to find some common ground. This paper represents a summary of the findings. The author is an economist and not a physicist. Therefore, he has examined the writings of some leading physicists regarding their own methodology, and he hopes that he understood them correctly. It is surely not their fault if he did not.

II

It has long been recognized that classical economics and classical physics had much in common. Both disciplines were based upon the same general philosophy of science, and, as a result, their methods were remarkably similar. They both held to the natural law philosophy of the 18th century with its implications of the isolated system and determinism in accordance with natural law. The "intelligence" postulated for the physical scientists by Laplace was fully accepted by the classical economists. For Laplace's "intelligence," if he knew the positions of all the particles in the universe, and knew the laws by which they were motivated, nothing would be uncertain. The future as well as the past would be before his eyes. The assumption was that natural laws determine all movements in the universe. John Stuart Mill expressed the same sort of philosophy when he said, "The laws and conditions of the production of wealth partake of the character of physical truths . . . Whatever mankind produces, must be produced in the modes, and under the conditions, imposed by the constitution of external things, and by the inherent properties of their own bodily and mental structures . . . There are ultimate laws, which we did not make, which we cannot alter, and to which we can only conform."[2]

The methods of classical physics and classical economics were also similar, as one might expect. Analysis consisted to a large extent of model description. It was a process of breaking the whole down into smaller and smaller parts, which could be analyzed in isolation, and from which generalizations could be drawn concerning the system as a whole. Max Planck notes: "Classical physics is based on the assumption that its laws are most clearly revealed in the infinitely small; for it assumes that the course of a physical event everywhere in the universe is completely determined by the state prevailing at this place and its immediate vicinity."[3]

The same idea is expressed by a contemporary economist, Edward Chamberlin: "A complex system may be better understood by breaking it into its parts, and the problem of the individual equilibrium will serve as a helpful introduction to the

[1]Planck, Max, *The Philosophy of Physics*, New York: Norton, 1936, 87-88.

[2]Mill, John Stuart, *Principles of Political Economy*, London: Routledge, 1891, 143.

[3]Planck, Max, *The Philosophy of Physics*, op. cit., 30.

more complicated one of the adjustments over a wide field."[4]

In both fields the solutions to the problems of model analysis were in terms of an equilibrium of forces. Just as the path that a body will take in space is a resultant of the forces acting on it, so the path of the economic man is the resultant of the economic forces acting on him.

III

In the 20th century both physicists and economists met problems that could not be solved without abandoning much of the traditional philosophy and method of science. The old conceptions of science were inadequate to formulate theories in either of these branches of learning.

In physics the problem of radiation required new philosophical and methodological orientation. Much of the newer methodology in this field dates from the formulation of the quantum theory by Max Planck. Planck's theory of the quantum of energy was the only way experimental results in radiation could be explained. Yet his equation could not be deduced from classical laws of physics, which require that radiation be continuous in accordance with the accepted wave theory. Planck's equation could be deduced only by making the assumption that radiant energy is emitted in definite and discontinuous units, which he labeled quanta. This new theory presumes a fundamental discontinuity in an aspect of nature—the dynamical aspect of nature—that had always before been supposed to be continuous.

Planck's formulation marked the way for further inroads upon the older conception of science. Following up the implications of the quantum theory, modern physicists have been forced to modify much of the old philosophy and method of science. Werner Heisenberg, utilizing the quantum theory, formulated the important Uncertainty Principle or Indeterminacy Principle. This principle clearly defines the amount of indeterminism in the classical system of thought. It states, for example, that both position and velocity of an elementary particle can never be known exactly. Only an approximate figure can be obtained if both are to be calculated. Either can be known separately to any required degree of accuracy; but the more precisely the one is measured, the less accurately the other can be ascertained. The connection between them is the quantum of action. This is but one example of Heisenberg's principle. Classical physics always describes by spatio-temporal and dynamical quantities. The Uncertainty Principle applies as between any pair of such conjugate quantities, e.g., time and energy as well as position and momentum.

It is the measuring process itself that produces the Uncertainty Principle. A quantum of action being involved in all electronic transactions, any observation of a particle must involve the release of or addition of a quantum of action to the particle observed. The quantum of action will affect the particle correspondingly. Hence, observation always involves interference. Because the quantum of energy is a product of both position and velocity, the more accurately the one is observed, the less accurately the other can be observed.

Heisenberg has thus shown that the study of more and more minute particles is futile. The physicist can never ascertain enough accurate knowledge of tiny particles to make adequate generalizations. The classical ideal expressed by Laplace, that if one had enough knowledge he could predict accurately, is disrupted. Heisenberg has shown that one can never have enough knowledge.

This new concept called for revision of much theoretical classical thought. Heisenberg himself has explained the importance of the new concept by pointing out that

> " . . . the resolution of the paradoxes of atomic physics can be accomplished only by further renunciation of old and cherished ideas. Most important of these is the idea that phenomena obey exact laws—the principle of causality. In fact, our ordinary description, and the idea of exact laws, rests on the assumption that it is possible to observe the phenomena without appreciably influencing them. To co-ordinate a definite cause to a definite effect has sense only when both can be observed without introducing a foreign element disturbing their interrelation. The law of causality, because of its very nature, can only be defined for isolated systems, and in atomic physics even approximately isolated systems cannot be observed. This might have been foreseen, for in atomic physics we are dealing with entities that are (so far as we know) ultimate and indivisible. There exist no infinitesimals by the aid of which an observation might be made without appreciable perturbation."[5]

This is not to say that Heisenberg's principle disproves the universe to be deterministic, for it does not. Determinism may be an aspect of the physical world; but because it cannot be proved to be, the physicist no longer assumes it to be true.

These conclusions have had a profound effect upon the methodological techniques of atomic physics. It is not that all physics of the past has been repudiated. It is rather that in describing elementary particles the methods of classical physics are unsuited. Niels Bohr has explained this by the Correspondence Principle. This principle shows that in proportion as the number of atoms involved increase, quantum laws approach more nearly to classical laws. If the physicist is concerned with baseballs or planets, which contain

[4]Chamberlin, Edward, *The Theory of Monopolistic Competition*, Second Edition, Cambridge: Harvard University Press, 1938, 74.

[5]Heisenberg, Werner, *The Physical Principles of the Quantum Theory*, Chicago: University of Chicago Press, 1930, 62-63.

many atoms, the difference obtained from quantum laws and classical laws is not measurable. The principle is fundamentally a statistical one. The old immutable laws are no longer taken to be absolutely exact or immutable. Rather they are statistical or probability laws, applying to a mass of phenomena but not applying to individual particles necessarily. Thus the emphasis has shifted. As Niels Bohr has said, ". . . we have been forced step by step to forego a causal description of individual atoms in space and time, and to reckon with a free choice on the part of nature between various possibilities to which only probability considerations can be applied."[6]

The atomistic method of approach that characterized classical physics has given way to an aggregate approach in quantum physics. It is statistical and deals with probabilities and aggregates. Model analysis in the old sense has no place. There is no attempt to show with mathematical precision what goes on in time and space. Instead of model description, the new physics is concerned with aggregates and probability distributions. The physicist cannot know, and does not even ask, "What is the speed of every particle at this moment?" But he can know, and does ask, "How many particles have a speed between 1000 and 1100 feet per second?" Individuals cannot be analyzed in both time and space. Only average values for aggregates can be determined. It is known, for example, that 1600 years hence half of one gram of radium will disintegrate. But it cannot be said, even in theoretical descriptions, which particular atoms are doomed.[7] Atomic theory gives statements of statistical nature only. It tells about the probability of possible transitions, but nothing about the transition of the individual atom. Furthermore, these statistical laws are abandoned entirely and laws governing aggregates are formed directly. That is, the aggregate laws are not formulated from a knowledge of individual cases because it is impossible to know both position and velocity of an elementary particle. Quantum physics deals only with aggregates. The description of individual cases had to be given up, and laws of a statistical nature have taken their place.

For the economist this statement of the methods of quantum physics usually sounds both startling and familiar. Economics is, at the moment, faced with problems much like those that faced the physicist at the turn of the present century. Classical laws of economics seem unable to provide a realistic description of important economic phenomena. And the modern economist is turning toward new assumptions and new methods that are strikingly similar to those of quantum physics.

The problem that caused economists to reconsider their assumptions, and hence their methodology, was the depression of the 1930's. Classical economics was unable to explain in a satisfactory manner this great tragedy. Its emphasis on the individual firm provided it with no real theory of the general level of employment as a whole. Although there was a theory of employment that applied to the individual firm, the theory seemingly did not apply to the aggregate situation.

It was John Maynard Keynes who set for himself the task of formulating a theory that would accurately account for fluctuations in the aggregate level of employment. To do so, however, he had to rid himself of many of the assumptions and techniques of classical thought. His awareness of the inadequacies of the classical assumptions is found in the following passage: "We are faced at every turn with problems of Organic Unity, of Discreteness, of Discontinuity — the whole is not equal to the sum of its parts, comparisons of quality fail us, small changes produce large effects, the assumptions of a uniform and homogeneous continuum are not satisfied." [8]

Here Keynes states in capsule form the essential philosophy of modern science. The extent to which it influenced his economics is evident in his analysis of employment. In the preface to the *General Theory* he points out: "The composition of this book has been for the author a long struggle of escape, and so must the reading of it be for most readers if the author's assault upon them is to be successful — a struggle of escape from habitual modes of thought and expression. The ideas which are here expressed so laboriously are extremely simple and should be obvious. The difficulty lies, not in the new ideas, but in escaping from the old ones, which ramify, for those brought up as most of us have been, into every corner of our minds." [9]

Keynesian theory drops the assumption that the whole is determined by the sum of its parts much as quantum physics has dropped that assumption. The great body of classical economics concerned itself with the analysis of the individual firm and the individual entrepreneur, from which generalizations were made concerning the economy as a whole. This approach assumed that the economy was composed of many essentially independent parts. Each business enterprise operated as a separate entity and the functioning of the whole system could be accounted for only as the sum of the individual parts. Keynes elaborated the idea that the whole is not always equal to the sum of its parts. Frequently the whole is quite different. For example, with modern security markets it is possible for the individual to revise his commitments hourly although it is not possible for the community to do so. Although the individual may withdraw his resources from one organization and

[6]Bohr, Niels, *Atomic Theory and The Description of Nature*, New York: Macmillan, 1934, 4.

[7]Einstein, Albert and Infeld, L., *The Evolution of Physics*, New York: Simon and Schuster, 1951, 298-300.

[8]Keynes, J. M., *Essays in Biography*, New York: Harcourt Brace, 1933, 286.

[9]Keynes, J. M., *The General Theory of Employment, Interest, and Money*, New York: Harcourt Brace, 1936, viii.

several hours later decide whether to return them to the original investment or put them elsewhere, the community cannot withdraw its resources from the steel industry and decide later what to do with them. Another example is this: reducing wages may be a way of increasing employment in one firm, but it may not do for the economy as a whole because of its effect on the total demand for goods. In addition to these examples one can cite cases of small changes producing large results. A small increase in investment may give rise to a large increase in the national income. This is a phenomenon now known to all economists as the multiplier. There are many other examples to draw from.

The rejection of the idea that the whole is but the sum of its parts has led to a new and different approach to the study of economics. Whereas the classicists spent their time analyzing the individual firm and making generalizations concerning the economy as a whole from that study, the economists of the new school concentrate their attention not on the individual firm, but on some aspects of the economy as a whole. The new approach is aggregate and statistical. The modern economist is not as concerned with the employment practices of the individual firm as he is about employment in the nation as a whole. He is not so much concerned with the demand for an individual product of an individual firm as he is about the aggregate demand expressed in the economy as a whole.

Furthermore, the laws he develops concerning the economy as a whole are not based upon individual laws, just as the laws of quantum physics are not based upon individual laws. They are statistical laws formulated directly. What applies to the individual need not apply to the whole economy.

IV

In conclusion it is to be noted that in recent years the philosophy of science has changed, or is changing. However, the physicists are far ahead of the economists in bringing about this change and in shaping their methodology accordingly. For at least fifty years many leading physicists have recognized that the older conceptions of the universe are incapable of being used to solve all problems; that they can be used only in areas where quantitative errors are negligible. Economists are just coming to this same realization. The depression of the 1930's forced a modification in their way of thinking and forced them to renounce some of the older conceptions of science. The new methods that are arising are strikingly similar to the methods of modern physics. It is not surprising that they should be so, for both disciplines are coming to accept the same philosophy of science.

What is surprising is that economists did not come to this realization much earlier. As economists have been dealing with phenomena that are indivisible for a long time, they might have expected that statistical and probability approaches would be more useful. Yet they imitated the ways of classical science until they were forced to do otherwise if they were to survive as theorists. And yet they frequently envied the physical sciences for their greater accuracy.

The greater accuracy of the physical sciences in prediction may be at least partially explained by Bohr's Correspondence Principle. The classical laws of physics, which are not recognized as probability laws, were laws governing a great many individual particles. The classical laws of economics were laws governing a much smaller number of individuals. Those laws formulated on the basis of greater numbers were, hence, much more accurate. This is a consideration that the economist needs to bear in mind. Because the physicist, in dealing with almost everything that can be seen, deals with many more individuals than the economist can even when he treats the economy as a whole. Hence, physics may always be more accurate in its predictions. This is not to say, however, that the economist must be satisfied with his present science. He may well increase the accuracy of his predictions by improving his methodology. And atomic physics, which deals with smaller numbers, may very well offer hope to the economist.

The great need in economics today is for a dynamic theory — a theory of economic development. The physicist offers much hope to the economist that something can be done in this direction. Quantum physics has shown us that when dealing with indivisible units, one cannot know accurately both spatio-temporal and dynamical quantities at the same time. The classical economists, interested in the spatio-temporal quantities, necessarily ignored dynamical ones. Their concern with the individual firm at a given instant in time and at a given point in space provided them with much information about the statics of the system, but it did not tell them where the economy was going. The success of physicists with dynamic theory, coupled with the evidence of common basic elements in the two disciplines, may well serve to advance economic science.

"It seems plain and self-evident, yet it needs to be said: the isolated knowledge obtained by a group of specialists in a narrow field has in itself no value whatsover, but only in its synthesis with all the rest of knowledge, and only inasmuch as it really contributes in this synthesis something toward answering the demand . . . who are we? . . ."

—Erwin Schrödinger, *Science and Humanism,* Cambridge University Press, page 5.

HUMAN DIMENSIONS

Stuart C. Dodd

University of Washington

A Re-Search for Concepts to Integrate Thinking

I. *On the Genesis of Integrative Concepts*

We seek the best set of integrating concepts with respect to the following criteria:

This set should *subsume* all other concepts, with none left out.

This set should *order* all other concepts into one system of knowledge.

This set of concepts should *generate* new concepts in an ever-expanding integration.

These three statements will be our functional criteria. They will guide our search for concepts to integrate human thinking. In the long run, such integrative concepts might help to integrate human living and education for it.

This search and re-search for integrating concepts has gone on through all the ages since men learned to use words. Theologians have tried to integrate the universe around two concepts: God and anti-God. Aristotle proposed ten basic categories. Kant proposed four (quality, quantity, relation, and modality) each with three subcategories. Adler is developing his "Syntopicon" as an encyclopedia of the 102 great ideas drawn from the "great books." These and many other proposals are based on the best experience and thinking of the past; they do not, however, use the scientific method of controlled experiments which can generate better thinking for the future.

These sets of concepts all propose solutions in part to the problem of unifying diversity. How can man unify the chaotic diversity of phenomena? By means of what symbols or concepts can he best respond to all the myriad phenomena about him? For this he must achieve as much as possible of two apparently opposite ends. On the one hand he wants the concepts to be few to adapt to his limited intelligence. On the other hand he wants close one-to-one correspondence of his symbols to their referents so that his concepts will describe reality more exactly and enable him to predict and control it better. This is the goal of all scientific conceptualizing. But the vast variety of phenomena in the cosmos calls for millions of names, or concepts.

Each field of science has generalized or found unifying concepts for the most part only within its part of the whole field of knowledge. Each field of science, furthermore, has developed its own language and notation which to some extent overlaps the language and notation of other fields without always showing clearly both the similarities and differences. (Our dimensional analysis described here and its "S-notation" attempt to help synthesize and standardize these languages and notations.)

In recent decades a better tool is being forged. Scientific method, the study of "what works," is increasingly being applied to the symbolizing process as well as to the phenomena to be symbolized. Scientists are studying their concepts as well as their referents. The sciences of mathematics and symbolic logic, statistics and linguistics and general semantics, the psychology of symbolic behavior and the sociology of group-communicating in a culture are all helping to give us new power over this old problem of choosing the best concepts. For we are learning how and when to discard inadequate concepts (like "phlogiston," "ether" and "the will") and create new concepts that are operationally defined to assure closer correspondence to phenomena for more users at more times and in more contexts. Thus the calculus of classes in symbolic logic is working out the rules for building hierarchies or systems of classes and their qualitatively differing subclasses. This combines unity in one respect (the class property) with diversity in other respects (the subclass differentia). All this semantic re-searching helps men to develop a set of unifying words with more exact meanings, yet more inclusive meanings. And, as top-level words include more meanings, fewer such words are needed. It is now becoming possible, for example, *to measure* just how inclusive or comprehensive a concept is; how universal it is to all cultures; how useful it is in frequency of being used; how precise it is in meaning; how constant or reliable is its meaning to different speakers, hearers, occasions, and contexts; and how valid a concept it is (in corresponding closely to what it is claimed to represent). In these and other respects we can measure, and improve increasingly with research, the structure and functioning of our concepts.

Applying scientific methods to concept building involves, among other steps, empirical testing of proposed concepts by pre-assigned techniques and criteria. The semantic scientist tests such an hypothesis as: "This proposed set of concepts, when tested by experimental procedure A, will increase variable X, a criterion, more than an alternative set of concepts when similarly tested." The scientist's job is thus to find the best means to given ends. The choice of ends, the uses to which scientific laws may be put, are value judgments and lie beyond the scientist. We here assume the value judgment, or end, of finding integrative concepts. This is spelled out a bit by our three assumed criteria, namely, that integrative concepts are concepts which subsume other concepts, order them in a system, and generate new concepts.

With this new possibility of a scientific genesis of concepts in mind, let us review briefly a structure of proposed dimensional concepts and then look at some of the evidence as to their integrative functioning.

II. *On a Structure of Integrative Concepts*

Our dimensional set of concepts is a product of a substantive class of concepts logically multiplied by a formative class of concepts. The substantive concepts are exemplified by "space," "time," "mass," "people," "behavior," "values," etc. We call these "sectors" as they cut across the situations in which they are recorded. The formative concepts, such as "quality," "quantity," "relation," and "system," etc., deal with the forming of substantive concepts. We call these "powers" as they are operationally defined by the mathematical exponents which raise a concept to a power. These and other formative concepts deal with operations and relations among concepts; they deal with the syntax of the concepts.

We shall sketch here only the *chief* sectors and their *chief* powers. The sectors will be illustrated from physics and social science. The sketch of the powers here will neglect the operators and other formative concepts. This is partly because an article is too short to discuss all sectors and all their powers. (The reader should consult the appended bibliography for fuller treatments.) But it is partly because the set is not closed; it is expansible; more sectors and higher powers may be used in the future.

A. The "Sectors," i.e., Classes of Substantive Concepts —

1. Space is the most familiar sector with its three dimensions of length, width, and height. A length multiplied by another length at right angles is a second power of length [$L^1 \times L^1 = L^2$] and measures an area. When multiplied by a third length at right angles, the product is a third power of length [$L^1 \times L^1 \times L^1 = L^3$] and measures a volume. The extent *to* which space pervades our thinking is suggested *by* the fact that all our prepositions (italicized *in* this sentence) can be traced back *to* spatial meanings *in* origin.

2. Time is the next most familiar sector with its positive first power [T^{+1}] denoting a duration and its negative first power [T^{-1} or $1/T$] denoting something divided by a duration, namely a change per period, a speed. Its negative second power [T^{-2}] denotes an acceleration, a change-per-period per period, a rate of change of a rate of change. Its zero power [T^0] denotes a unit of time which may be as small a unit as desired, even down to the infinitesimal units of the differential calculus.

Time intimately pervades our thinking. We think in time, with each thought, such as the words and sentences in a language, occurring in a time sequence. Every verb can be shown to have time as a factor since a verb denotes an acting, a happening in time. (Even the copula can always be interpreted as expressing existence at some time.) If the origin point on the time dimension is a general one, we have *dates;* if it is an individual origin, we have *ages* of those individuals; if it is the moment of speaking, we have the past, present, and future *tenses* of time relative to it. The outline of this paper in genetic, structural, and functional sections deals respectively with the past, present, and future tenses of conceptualizing. If the units of time are cardinal clock periods, we have periods of hours, days, years, etc., defined. If the units are ordinal sequences, we have the essential factor defined in such basic word pairs as "before and after," "early and late," "cause and effect," "stimulus and response," "action and reaction," "means and ends," and all concepts of memory in the past or of purposes in the future.

3. Space and time are sectors common to all the empirical sciences. The further substantive sectors are distinctive to each field of science. Thus if the concept of "mass" is combined with space and time, the field of physical mechanics is thereby defined. For every single formula of physical mechanics is reducible or re-expressible as a product of length, mass, and time (as developed further below). If the concept of "temperature" is included in the basic set, all the formulas of thermodynamics become re-expressible in terms of these four sectors (and their powers). If the concept of "charge" is included, all the formulas of electrostatics and electro-magnetics become reducible to these five sectors. These five sectors or classes of dimensions, can subsume the formulas of physics almost completely. (Relativity physics is not, as yet, as readily reducible to dimensional analysis as the rest of physics.)

4. The field of chemistry seems dimensionally analyzable when a sixth sector of the number of particles is included in the basic set of sectors. The field of biology has not been dimensionally studied as fully. "Cells" and perhaps "organs" and "organisms" have been proposed as needed, further

Table 1

A Hierarchy of the Sciences

Field of Empirical Science		as defined by distinctive sectors
Science X_u	=	the universal class, all concepts.
Geometry	L C =	space and its complementary class.
Kinematics	L T C =	time also is differentiated out.
Mechanics	L T M C =	mass is differentiated out.
Thermodynamics	L T M Θ C =	temperature is differentiated out.
Electrostatics, etc.	L T M Θ Q C =	charge is differentiated out.
Chemistry	L T M Θ Q Æ C =	atoms are differentiated out.
Biology	L T M Θ Q Æ B C =	biological cells differentiated out.
Demography	L T M Θ Q Æ B P C =	people are differentiated out.
Behavior Sciences	L T M Θ Q Æ B P Å C =	human action is differentiated out.
Value Sciences	L T M Θ Q Æ B P Å V C =	values are differentiated out

sectors. It may develop that the number of particles will be useful at various levels of compounding the particles. Thus the particles could be quanta of energy, or electrons, etc., or atoms, or molecules, or cells, or organisms, or persons at the successive levels. Compounding in this way as suggested in Table 1, the basic concepts of each field of science can be specified. Then the extent to which they subsume and order and generate other concepts seems determinable, though as yet this has been done only for physics and sociology.

5. The field of sociology and of the human sciences more generally has been dimensionally analyzed. (See References 1 and 2.) It has been wholly reduced to sectors of three degrees of determinateness. The most determinate human sectors are space, time, and people. The least determinate human sector is the inevitable "residual sector" described below. In between these two extremes are sectors on trial still, such as the sector of "behavior" and of "values" discussed here. Let us examine each of these sectors a bit more closely.

The sector of people means simply any human population. It is measured by the sheer number [P] of people in a population. It may be symbolized by the letter P. It is the sector distinctive to the human sciences from human physiology through all the social sciences and on to the humanities. It is intensively studied in demography.

6. Next the "residual class" should be introduced. It is a unique and essential part of our dimensional analysis. The residual class is defined in logic as a complementary class including *all not* in the other classes. It is the class of "all else" with respect to some specified class or classes. Thus in the set of sectors specified as "space, time, people, and all else" the residual sector or class of concepts comprises all concepts other than space, time or the number of people. This complement class is very useful in making a closed system at the symbolic level. With this complement class included, theorems (such as DeMorgan's Laws) and other relations in the logic of classes can be deduced with rigor.

These residual concepts form a vast class of concepts, covering many now known and all unknown or undeveloped concepts. As fast as possible, researchers try to specify and measure more and more concepts which are in this class and which correspond to phenomena about us. Its size measures our ignorance and challenges research. Any given study may use any number of concepts which are not space, time, nor people and hence are subclasses of this residual class. As soon as any subclass demonstrates fitness, it may be promoted to being called a "sector" coordinate with the sectors of space, of time, of people, etc. To demonstrate such fitness, a class of concepts should show equal ability:

a. to subsume other concepts comprehensively;

b. to order other concepts systematically;

c. to generate other concepts usefully.

It should further fulfill these three functions with a high universality of use in time from now into the far-foreseeable future, in space from

equatorial to polar cultures, and in the population from highest to lowest strata.

7. We shall here discuss only the two subclasses of the residual class for the human sciences which are candidates on trial for sectorhood.[1] These are the concepts of human "behavior" and human "values." These concepts are candidate sectors largely because they emerge with so many new properties that even if they should prove reducible to combinations of the other sectors, yet it is convenient at present to use them as coordinate sectors.

Human behavior means any activity of people. It includes speech behavior or symbolizing generally. It includes any preparatory behavior called an attitude, as inferred from its observable manifestations. It includes the entire range of behaviors from most reflex to most purposive, from least to most conscious, from most internalized to most externalized. It is thus any person's response of any kind to stimulation from any source. Out of this huge class of all human actions, one particular kind of act will generally be isolated in a given study. The dimensional formula below applies most clearly to one kind of behavior at a time. For complex series and patterns of behavior, matrices of indices of behavior must be used, though even these symbolic devices are inadequate still to describe all the complexities of human behavior.

8. Our final sector to be dealt with here is the class of concepts called human values. We define "a value" operationally as a desideratum, an object of desire ("to somebody, sometime, under specified conditions," being understood). The values of a population may be measured to a first approximation by a poll asking people in suitable ways what they want most. Their asserted objects of desire (in the absence of pressures to falsify or conceal) can reflect, by and large, what they want in life, their values. This assumes that the validity of such polling is high, i.e., that the correlation of speech and action is high.[2] This assumption that polls can be validated by measuring their agreement with people's behavior can be tested experimentally. This validity seems high under mass conditions making for sincerity and articulateness in responding to the poll interviewer.

[1] Among other candidates for sectorhood, concepts of "desiring," "social temperature," "stimuli," and "symbols" are prominent and should be noted. The intensity of "desiring" any object of desire is operationally defined by what a person will do, give, or say to get an object of desire. It thus seems to merge into the concept of behavior which can always be interpreted as striving for something or responding to some stimulation. It seems to mean largely what J. Q. Stewart calls "social temperature" or intensity of interactivity (of people instead of vibrating molecules). "Stimuli" includes all our "values" as here defined. The word "values" seems to mean to most people conceptualized stimuli. "Symbols" may prove reducible to a subclass of behavior, namely "symbolizing behavior." Thus, as dimensional research proceeds, candidate concepts may prove to be compounds resolvable into other more basic concepts.

[2] Psychologists mean by "validity" a high correlation between a new and an accepted measure of some phenomenon.

This behavioristic definition of *a value as something people want* reduces (but does not dismiss) the most mystic or abstract values into entities which can be scientifically observed and empirically ordered in hierarchies of values or value systems. This inclusion of the concepts of human behavior and values in our dimensional system means that behavioral aspects of the social sciences and the humanities can, to a large extent, be dealt with by dimensional formulas.[3]

B. The "Powers," i.e., Some of the Classes of Formative Concepts —

1. Qualities, X^0. Quality, or difference of kind, is the "zero power" class of concepts. It subsumes all words meaning different kinds of things in contrast to the class of quantitative concepts which subsumes all words meaning different degrees of one kind of thing. We have developed an exact operational test in the form of a statistical index to distinguish between a quality and a quantity. (See References 15 and 16.) The reason for calling it a zero power is that it can be symbolized by a zero exponent according to the rules of algebra and symbolic logic. (See Reference 13.)

2. Quantities, X^1. A quantity means any degree or amount of one quality. This class of concepts includes all-or-none quantities, ordinal quantities such as "some, more, most," or "first, second, third, nth," and cardinal quantities such as "1, 2, 3, . . ." It includes the whole field of mathematics, just as qualities include the field of logic and most of language. Quantities in mathematics are assumed to be of the first power (i.e., with exponents of 1) unless otherwise specified.

3. Relations, X^2. A relation connects at least two qualities or quantities. It can be often thought of as a product of a pair of entities, for it exists only in the pair and not in either factor alone. Thus the 6 in "$2 \times 3 = 6$" is a quantitative pair product or relation, while the class of wives in "wife = woman x married" is a qualitative or logical product of the class of women and the class of married people. Logic and mathematics are largely concerned with relations of many kinds. About half of all spoken or written syllables in any language deals with relations including all grammar and syntax. Since every relation must have at least two "factors" in it, it can be dimensionally symbolized by an exponent of 2 which denotes a "second power."

4. Systems, X^{3+}. A system is a combination of qualities, quantities, and relations. It may be a complex "product" of diverse sub-systems, but this product will always have more than two factors and so is dimensionally symbolized by an exponent

[3] For a fuller discussion of this "values" sector, see References 1, 2, 3, 6, 10, 11, and 12.

of 3 or more [X^{3+}] and called a class of concepts of the third or higher powers.[4]

III. *On Some Functions of Integrative Concepts*

With this set of dimensions in mind, the question now becomes: How well do they fulfill the three integrative functions? How well do the substantive sectors (of space, time, people, behavior, values, and residuals, for the human sciences, for example) and their formative powers (of quality, quantity, relation, system, etc.) subsume other concepts, order them, and generate new ones?

A. The Subsuming Function —

This set of concepts must subsume all concepts, of course, by the very definition of the residual sector. Since this includes whatever the other concepts do not subsume, nothing can be left out. At the symbolic level, a closed symbolic system, exhaustive of all concepts, all words, all meanings, has been achieved by the semantic device of defining the "all else" sector. At the phenomenological level, the problem becomes to keep this residual sector as small as possible. Towards reducing the residual concepts, the semantic sciences are developing powerful new techniques. These techniques include the increasing ability of scientists to measure the size of the residual, and still unknown, sector in many situations (such as by computing coefficients of non-determination between two correlated variables).

[4] Two further classes of formulative concepts not discussed in this brief treatment are the "operators" and "modifiers."

The logical and mathematical operators specify the operations and relations among other symbols. They include such symbols as +, —, ×, ÷, =, etc. We denote the class of operators by a semicolon [;] in our typewritable and standardizing and interdisciplinary "S-notation" for dimensional analysis.

The modifiers help to specify the particular indices or operationally defined concepts within each sector and power. A sector-and-power class is called "a dimension"; an index, such as a statistical index number, is a subclass of a dimension, a particular concrete case of a class of concepts within one sector and at one power. Other modifiers may specify members of classes, units of quantitative indices, origin points, limits, ranges, etc. In our S-notation, scripts at the four corners of any index symbolize the modifiers with exactness. (See References 1 and 2.)

Table 2

The Sectors and Powers Cross-classification

$\mathrm{I}^{\mathrm{X}}_{\mathrm{X}}$	4 Powers ($\mid^{\mathrm{X}}$) of each sector			
Classes ($\mid_{\mathrm{X}}$) of Dimensions	X^0	X^1	X^2	X^3
Length, L	L^0 a point	L^1 a line	L^2 an area	L^3 a volume
Time, T	T^0 a date	T^1 a period	T^2 an acceleration	T^3 an accelerating acceleration (a factor in power)
People, P	P^0 a person	P^1 a plurel	P^2 a group	P^3 an organization
Desiring, D	D^0 the attribute of desiring	D^1 a degree of desiring	D^2 2 positively or negatively correlated desirings	D^3 a complex of at least three desirings as factors
Desiderata, V	V^0 one kind of human value	V^1 an amount of a value	V^2 a correlation of 2 values	V^3 three values as factors, e.g., social control, etc.
Complementary I	I^0 a class (in Logic)	I^1 a variable (in Math)	I^2 a correlation (in Statistics)	I^3 a system (in Social Physics)
Averaged as statistical moments $\sum \mathrm{X}^{\mathrm{X}}/\mathrm{P}$, in human distributions	$\sum \mathrm{X}^0/\mathrm{P} = 1$, the unit population, zeroth moment	$\sum \mathrm{X}^1/\mathrm{P}$ = a mean, first moment	$\sum \mathrm{X}^2/\mathrm{P}$ = a variance, or a correlation, a second moment	$\sum \mathrm{X}^3/\mathrm{P}$ = a skewness, third moment
A sample compound of rows TPI above	$\mathrm{T}^0\mathrm{P}^0\mathrm{I}^0$ an attribute of a person at a date	$\mathrm{T}^{-1}\mathrm{P}^1\mathrm{I}^1$ social momentum	$\mathrm{T}^{-2}\mathrm{P}^2\mathrm{I}^2$ social energy (as in demographic gravitation)	$\mathrm{T}^{-3}\mathrm{P}^3\mathrm{I}^3$ (unmeasured as yet) an example may be: an organization's power of social control

Table 3

Some Compound Concepts
in Physics (upper entries) and
in Sociology (lower entries)

Dimensions	T^{-1}, Time	T^{-1}, Time
Distance, L or any social index, I multiplied by:	LT^{-1} = Velocity or IT^{-1} = Social Velocity, a change per period	LT^{-2} = Acceleration IT^{-2} = Social Acceleration, a change-per-period per period
Mass, M or People, P multiplied by:	MLT^{-1} = Momentum PIT^{-1} = Social Momentum, a population's velocity	MLT^{-2} = Force PIT^{-2} = Social Force, a population's acceleration
Distance, L or any social index, I	ML^2T^{-1} = Action PI^2T^{-1} = Social Action, a population's correlated activities	ML^2T^{-2} = Energy PI^2T^{-2} = Social Energy, a population's correlated accelerations

Some evidence on the smallness of the residual sector may be inferred from the five summary statements below. These are examples from sciences which have been dimensionally analyzed, utilizing only non-residual sectors. For a fuller qualifying discussion, the references should be studied.

1. The formulas and principles of logic and of mathematics are expansions of their primitive terms, which in turn are included in our dimensional system.
2. The formulas and principles of physics can be rewritten in terms of these dimensional formulas.
3. The formulas of statistics can be shown to be special cases and combinations of one very general dimensional formula for any statistical moment.
4. The formulas and principles of the social sciences have been re-expressed in dimensional terms with experimentally measured, high reliability.
5. The connective half of spoken and written language has been wholly reduced to ten dimensions in the logical inter-language called Tilp. (See Reference 9.)*

B. The Ordering Function —

One of the ways in which our dimensional concepts build order and unity throughout knowledge is shown in the hierarchy diagram (Table 1). This diagram suggests how the distinctive sectors of each science differentiate out from the universal class or sector of all possible knowledge. As the successive sectors emerge, each defining a field of science, they progressively build up an orderly hierarchy of advancing scientific knowledge. New sciences thus steadily reduce the residual domain of ignorance and of folk knowledge. The upper part of this hierarchy is more firmly established and tested by scientists than the younger and more controversial lower part. Better concepts or grouping of phenomena may be expected. Thus, as noted above, the concept of "particles" may prove to subsume usefully the concepts tentatively listed in this hierarchy such as the electric charge units, the atoms, the cells, and the people.

This "hierarchy" follows from the fact that sciences listed earlier above never use the distinctive sectors of sciences listed later; whereas the later sciences may or may not use all of the sectors listed earlier.

Another way that dimensions help to order knowledge is by cross-classifying the sectors and their powers. Table 2 shows six sectors, each at the zeroth, first, second, and third power. The twenty-four dimensions in the cells suggest, as briefly as a word or phrase can do so, the concepts of one sector at one power.

This sector-power cross-classification yields a classificatory number for each dimension in the cells. This number serves (somewhat like the atomic numbers in chemistry) such varied functions as:

to specify the properties of a dimensional formula;
to specify subfields of science in textbooks, etc.;
to classify, file, and index situations or data in any science.

A third way in which dimensions order other concepts is by defining compound concepts. Thus

"speed" is a compound of something divided by time;
"force" is a product of a mass and an acceleration;
"energy" is a mass times a speed squared, etc.

Such concepts are compounded from the sectors in physics and in sociology alike. Thus Table 3 exhibits some standard concepts such as force and energy in both physical and in social form. Such concepts in common build a more orderly unity among the sciences.

*Ed. Note: A description of Tilp will appear in a future issue of MAIN CURRENTS on language, semantics, metalinguistics, and related subjects.

C. The Generating Function —

Our third criterion for choosing the best set of integrating concepts was that they should function so as to generate new concepts.

One prolific way of creating new concepts is to redefine in operational terms the current concepts that are vaguely bounded in folk usage. The redefining may be done by applying our formative concepts to substantive concepts by regular rules of logic and statistics. For example, our 100 rules for writing S-formulas have helped to give exact technical definitions to more than five hundred of the most used concepts in the social sciences. (See Reference 1.) This creates a new vocabulary helping to make any field of study become an exact science.

Another way to generate concepts usefully is to combine concepts by definite rules. Thus the six chief sectors in the humanities may be cross-classified or "multiplied" logically by the four powers. This yields twenty-four concepts as in the cells of the table below. Some of these concepts are unnamed still and require a phrase to state them here. Table 4 shows in a page what might take a chapter to write out. It shows how the phenomena of human values, the choosing and striving behavior of people, can be analyzed first into six sectors as summarized in the sentence: *"Valuers are valuing the valued under time, space, and other conditions."* Each of these six value sectors needs to be observed in one or more reliable and valid statistical indices. Then each index is expanded to each of its first three powers. This is done by computing the statistical moments for any given index. A suitable product of these moments of indices defines the new index (or matrix of indices sometimes) which are called a "valuance." This valuance concept might be called a "transact" by Dewey. It could represent the complete patterning of people's value-behavior-in-situations including all its past history and the future expectations and motivations involved in it. Our "valuance hypothesis" then is the empirically testable assertion that the valuance index will correlate highly and reliably with a relevant and later index of human choosing or striving behavior. Thus valuance indices could be systematically developed to predict how people will vote or buy, attend or read, work or play, dream, aspire, or plan, or engage in any other evaluative activity.

Table 4

20 DIMENSIONS OF "VALUANCE"

A dimensional formula analyzing the phenomena of human values into their chief factors and their powers to aid in predicting human choosing and goal-directed behavior which is symbolized by B here.

Index of "Valuance"	"Valuance"	is defined as a product of	valuers	valuing	the valued	under temporal,	spatial,	and other conditions.

$$\left[I_V \overset{\text{def.}}{=} p^{0,1,2} \cdot D^{0,1,2} \cdot V^{0,1,2} \cdot T^{0,1,2} \cdot L^{0,1,2} \cdot C^{0,1,2}\right]$$

where each of the six factors may be raised to the zeroth, first, or second powers denoting respectively, qualities, quantities, or relations, i.e., kinds, amounts, or correlations of the factors.

The "Valuance" Hypothesis: "Valuance," between indifference and satiety limits, correlates highly with and so predicts, later relevant human behavior, i.e., $R_{B \cdot I_V} > .71$ acceptable at the 5% confidence level. This R means that R^2 exceeds one half the determination of B.

In colloquial terms:

6 "factors"	3 "powers" (of each factor)		
	Zero power, qualities	First power, quantities	Second power, relations
Valuance is greatest if:			
if the WANTERS include	most of a MAN,	most MEN and	most GROUPS
if the WANTING includes	most WAYS,	most DEGREE, and	most EVENNESS among men
if the WANTED includes	most VARIETY,	most AMOUNT, and	most EQUALITY among men
if the TIMING includes	most OCCASIONS, (i.e., most probability)	most DURATION, and most IMMEDIACY	most ACCELERATION and most STEADINESS
if the SPACING includes	most PLACES,	most NEARNESS, and	most AREA
if the OTHER CONDITIONS include	most KINDS of favoring* conditions,	most AMOUNTS of each favoring* condition,	and most CORRELATION of favoring* conditions

*A condition is a favoring one to the extent of its positive correlation with an index of one predicted behavior.

IV. *Summary*

In conclusion, we see that the scientific method of studying what works instead of traditions can be applied to concepts or language and symbol systems generally. We see one of the methods of science — called dimensional analysis — as helping to integrate human thinking by providing a small but fruitful set of substantive and formative concepts. We see these as subsuming all concepts in an orderly system which can generate further intellectual growth indefinitely on into the future. We see one particular dimensional analysis called Tilp as suggesting how analytic languages may change human thinking and consequent living in the future. These changes cannot be conceived fully at present because the very concepts to conceive them by are largely unconceived as yet, but dimensional concepts point that way.

Relevant Bibliography of the Author

1. Dodd, S. C. *Dimensions of Society,* Macmillan, 1942, pp. 994.
2. ——. *Systematic Social Science,* University Bookstore, Seattle, 1947, pp. 789.
3. ——. "A Tension Theory of Societal Action," *Amer. Soc. Rev.,* Vol. IV, No. 1, February 1939.
4. ——. "A System of Operationally Defined Concepts for Sociology," *Amer. Soc. Rev.,* Vol. IV, No. 5, October 1939.
5. ——. "A Systematics for Sociometry and All Science," *Sociometry,* Vol. XI, No. 1-2, May 1948.
6. ——. "A Verifiable Hypothesis of Human Tensions," *Int'l. Jour. Opin. and Attitude Res.,* Vol. IV, No. 1, Spring 1950.
7. ——. "The Interactance Hypothesis: a gravity model fitting physical masses and human groups," *Amer. Soc. Rev.,* Vol. XV, No. 2, April 1950.
8. ——. "Dimensional Analysis in Social Physics," read at AAAS Sections K and M, December 1950, Cleveland.
9. ——. "Tilp—a Ten Letter Alphabet of Meanings," *Gen. Sem. Bull.,* No. 6 and 7, Spring-Summer, 1951.
10. ——. "On Classifying Human Values—a step in the prediction of human valuing," *Amer. Soc. Rev.,* Vol. 16, No. 5, October 1951.
11. ——. "How to Measure Values," *Research Studies,* State College of Washington, Vol. XVIII, 1950.
12. ——. "Historic Ideals Operationally Defined," *Public Opinion Quarterly,* Fall, 1951.
13. ——. "Something out of Nothing," *Main Currents in Modern Thought,* Vol. 8, No. 4, February 1952.
14. ——. "All-Or-None Elements and Mathematical Models for Sociologists," *Amer. Soc. Rev.,* Vol. 17, No. 2, April 1952.
15. ——. "A Simple Test for Predicting Opinions from their Sub-Classes," *Int'l Jour. Opin. and Attitude Res.,* Spring, 1948.
16. —— and Buechley, R. W., "Subrelations," (unpublished).

DECLINE AND RECONSTRUCTION IN PHILOSOPHY

Frederick Mayer

University of Redlands

The philosophers of the 20th century, in the main, live in the shadows of the classical systems of philosophy. The disciple spirit is so strong in our time that much of our philosophy is characterized by second-rate thinking. We tend to lose sight of the vital problems of philosophy and, instead, dwell upon superficial and trivial issues.

What is most unfortunate today is the confusion regarding the function of philosophy. Some believe that its only task is to clarify the categories of science; others assert its function is that of logical analysis; another school urges phenomenological research. A vital philosophy, however, must have a definite relationship with life. It must aid in building a better and more adequate future.

To some extent, we have been blinded by the advances of modern technology and the scientific spirit. Modern man relies upon science in the same way as mediaeval man looked upon theology. The scientific age has improved our communication, it has enhanced our control over nature, but it does not promise automatic solutions and spontaneous progress. We must understand, therefore, the limitations of science and not regard the present-day theories as absolute.

It must be stressed, however, that philosophy should not regard science as an inferior method. No thinker of the 20th century can ignore the methodology which characterizes our natural sciences. Much of metaphysics and epistemology is still in a pre-scientific stage. Traditionalism is still strong. We have not sufficiently comprehended the importance of the new theories of psychology and biology, the significance of Einstein's theory of relativity and of Heisenberg's principle of uncertainty. A change of emphasis is needed.

The philosophical schools today are fighting a bitter war. There is immense antagonism between the idealists and the realists, between the naturalists and the personalists, and between the existentialists and the logical empiricists. A certain amount of intellectual controversy is invigorating. But when such warfare becomes an end in itself, it tends to distract from the real function of the philosophical enterprise. What is needed, then, is more cooperation and a spirit of mutual understanding and compromise.

Thinkers today tend to ignore the important problems of our time. Instead of a treatment of such vital problems as technology, various political ideologies, the future of the state, we find pronouncements upon traditional problems of phi-

losophy. Yet it is not enough today to restate the views of the 18th century. Philosophy has to deal with more concrete problems, which have a direct bearing upon the future and the survival of civilization.

The philosophy of the future will demand a more exhaustive study of mathematics and of the sciences; a more exhaustive view of actuality. Traditionally the worlds of action and of contemplation have been divorced. Yet the thinker has an obligation to humanity, and he cannot escape it through intellectual asceticism. No real progress can be achieved until intelligence becomes functional and is used in the solution of political, social, and economic problems.

The danger is that when philosophy becomes more concrete and more socialized, it may become merely an apology for prevailing political and economic institutions. This demands an integrity on the part of the philosopher, who must have a sense of his vocation and an understanding of the importance of his mission. The spirit of irrationalism has made rapid headway in 20th-century culture. This escape from reason has opened the door to subtle superstitions and has weakened the vitality of intellectual life. Yet without a faith in reason, without a sense of proportion and moderation, we will constantly go to extremes. This point of view does not imply that we should neglect the contributions of thinkers like Freud and Nietzsche, but it demands a sense of discrimination in evaluating their theories. It is time that we renew our faith in intelligence, and that organized knowledge is used functionally in advancing civilization.

Above all, the philosophers of the future should pay more attention to the problem of education. Many inadequacies in the present system are due to a lack of fundamental purpose. Too often education has been concerned merely with a quantitative accumulation of facts, and the spirit of philosophic insight has been utterly absent. Philosophy can give the teacher a sense of vocation, and it can eradicate the spirit of provincialism which is so strong in our century. As yet we have not sufficiently developed the potentialities of the philosophical discipline. Philosophy can mediate between science and religion, between facts and values, and it can give to modern man the sense of integration which he so desperately needs.

The thinker in the United States is hindered to a great extent by the utilitarian tradition. We are too much interested in practical applications; we tend to be superficial in our hypotheses, and we dislike strenuous intellectual discipline. These may be signs of a plebeian culture, as Santayana suggested, or they may simply indicate a cultural lag. It is quite certain, however, that without an emphasis on the philosophical enterprise, American culture will have a shallow foundation. We must understand, as Socrates pointed out, that the unexamined life is not worth living. Philosophy can make us less extroverted, less bombastic, and less credulous. It can give us a better appreciation of inwardness, more humility, and a clearer perspective regarding our own accomplishments.

Another alternative is open to us. We can continue upon the path of quantitative advancement with a blind faith in outworn formulas and in an ever-expanding technology. We can trust naïvely the opiates which our society offers. If we pursue this path, our future will indeed be somber.

Philosophy does not promise an automatic solution to the problems of our civilization. It cannot create by itself an era of peace, prosperity, and universal understanding. Still, philosophy offers a *method* whereby we can approach problems in a more scientific manner.

We can view the present as a *desperate race between the atom and the thinker.* So far atomic power has out-paced philosophical thought. The philosopher must produce more than epistemological controversies through a *systematic misuse of words;* he must contribute more to mankind than *organized uncertainty.* More than ever he must struggle against dogmatism and irrational absolutism in his endeavor to apply the fruits of reason to the institutional life of man.

Program for Reform

What are the concrete steps which can be taken to revitalize philosophy?

(1) Philosophy courses should be introduced into the high school curriculum. This demands a simplification and humanization of philosophy. Yet every high school student should be acquainted with the history of ideas, with the basic principles of logic and semantics, and with fundamental human values.

(2) Courses in moral philosophy should be required in every university. This does not mean a return to a theological concept of ethics; rather it means a new emphasis upon the values and ideals which are basic in civilization.

(3) A complete reorganization of introductory courses should be undertaken. Many of them today repel the student. Introductory courses should be taught through the core curriculum by the most dynamic thinkers, not by immature instructors.

(4) There should be a new emphasis upon courses in social philosophy; especially political philosophy, philosophy of law, and philosophy of education. A concerted effort should be made to have professional philosophers teach the theory of education.

To make this program effective, philosophers should re-examine their teaching methods and should cultivate an attitude of fallibilism. Philosophers in the past have often adhered to traditionalism and frequently rejected new ideas; today they must realize that much of the past is obsolete and that, as guardians of civilization, it is their task to bridge the gap between technology and ideas and between science and morality.

INTEGRATIVE PROGRAMS IN COLLEGES

Accounts of Three Educational Experiments Widely Varying in Methods and Aims

Ed Note: It has been our custom from time to time to note in these pages experiments in integration which are going forward in various educational centers around the country. We offer three accounts of such programs in the following pages. These are widely varying in their methods and aims—one being designed for specialists in the natural sciences, one for the undergraduate curriculum, and one for adult education—but all bring forward many points which are of general interest.

The first of these is concerned with the natural sciences. The Albertus Magnus Lyceum for Physical Science was founded at the Dominican House of Studies, a Pontifical Institute at River Forest, Ill., for the investigation of the basic theoretical problems of contemporary science with the purpose of contributing to the common task of the integration of science. During the summer of 1952, the Lyceum conducted a six-weeks summer school, whose attendance was limited to a group of twenty men, working in the field of theoretical science, teaching, doing graduate or research work in physics, chemistry, biology, or psychology, and interested in relating their special field to general physical theory. The basic program for the summer school was outlined as follows: (1) Mutual discussion and analysis of the most important contemporary problems in physical theory; (2) Consideration of the Catholic physical theory and its revelance in the face of these problems; (3) Study of some of the consequences of this physical viewpoint for physics, cosmological theory, chemistry, biology, and psychology. Following is a statement by William H. Kane, O.P., in which he discusses the background and philosophical bases of the work done at Albertus Magnus Lyceum.

UNIFICATION OF THE NATURAL SCIENCES

William H. Kane, O. P.

Dominican House of Studies

Charles Darwin once admitted that he did not know whether his work on the origin of organic species had permanent value, because his limited knowledge of logic did not permit him to make a critical judgment of the matter. Although it can be doubted that he had genuine knowledge of what a species is, nevertheless Darwin surely grasped the primary truth that man is a part of nature. Man is a natural being, just as natural as the birds and beasts, and just as truly an animal.

This truth is so evident that no one has seriously doubted it. Certainly it needs no extended proof. Aristotle disposed of the point in a few words by noting that man is generated by man, and so is part of the natural order of things which are subject to motion and to generation and decay. This does not mean that Aristotle thought that man is just another animal, or nothing more than an animal. Man is a good animal, one capable of acquiring splendid virtues by the right use of his distinctive powers of reason and choice.

But because he is an animal and a part of nature, man cannot be understood apart from nature, nor can nature be understood apart from man. Hence the science of natural things extends to and includes the scientific consideration of man.

It is man himself who develops natural science. What a man thinks about the world of which he is a part is of fundamental importance in his thought and life. It is the sensory world which is presented to us at the dawn of reason. From our experience of this world we somehow acquire our basic knowledge of being and not-being, of distinctions among things, of unity and multiplicity, likeness and difference, truth and error, good and bad. If we fail to apprehend the predominant uniformities among natural things and processes, if we overlook the great goods which are regularly produced by natural agents, if we think—as Darwin did—that accident, pain, and evil predominate in nature, then we have no alternative but to attribute everything to blind necessity and chance. In these circumstances we see no trace of a divine wisdom and goodness manifested in the world. If there is no law in nature which reason can apprehend and approve, if there are no regularities, no determined principles working for definite goals which are worth the attaining, then all is vanity in the most absolute sense. We have no evidence for God nor any foundation for morality.

Unfortunately there are persons who take this view of the world, or somehow have had it thrust

upon them. Their impression seems to be determined not by wholesome experience but by narrow and particular considerations. We judge of things in the light of what we think we know best, whether it is the pain of a chronic ulcer, the trembling of the earth, or the pulsations of a variable star. But whether we are scientists or not, whether we see the obvious uniformities and goods of nature or fail to appreciate them, the fact remains that what we think about this world is the foundation of all our knowledge and the key to our thought and life.

In recent years much has been written and said about the decline of religious belief and practice among all classes of society, particularly among the more educated. An excuse if not a reason for this state of affairs is that natural science is said to have removed all rational foundation for religion and morality. To people of ordinary intelligence this pretension would seem comical except for the fact that it is believed by so many who ought to know better. Hence it is reasonable to ask what in modern natural science is responsible for these strange views of the world and of man.

In attempting to answer this question we observe at once that the magnificent unity and harmony of the natural world is by no means reflected in modern natural science. There is today no scientific view of the world as a whole, but only a jigsaw puzzle presented to the student in weird and unintelligible pieces. There is no unified natural science which is developed from a single set of principles through orderly divisions and definitions of natural things to the manifestation of their intelligible reasons, properties, and relations. A unified natural science was indeed projected by Aristotle, who not only laid its foundation but also built something of a super-structure, however incomplete and imperfect. But modern natural science is a mutilated corpse.

The chief parts of modern science are physics and biology. The modern physicist prefers to view the world through mathematical spectacles and to see only the measurable aspects of things. Holy Scripture tells us that God made everything according to number, weight, and measure. Certain it is that everything in the world has measurable aspects, and the mathematical physicist is taking the measurements as best he can and correlating them in laws and theories from which he can deduce the known measurements and predict others which are to be made. He knows only the relations of quantities, and many of these he knows fairly well. He does not know what quantity is or what anything else is. He does not know what motion is, or what are the principles and causes of motion. He does not know what is the thing which is moved, or what makes it move, or why it is moved. These problems cannot be solved through mathematical principles, which are concerned only with the relations of quantities and nothing more. The mathematical physicist may not be expected to know what nature is, yet he cannot escape the knowledge that the sum of natural things and processes is an orderly world, not a chaos.

The modern biologist looks at everything through the matrix of evolution and seems content to think that the complex comes from the relatively simple, the more perfect from the less perfect. He treats of things which are more evident and knowable to us than the things which are considered in mathematical physics. But because mathematical physics is regarded as the most universal and most highly developed part of natural science, some biologists are tending to a mathematical biology, and even psychology is becoming mathematical. Assuredly the quantitative aspects of organisms and of all their various functions and activities can be measured directly or indirectly. Much knowledge which is interesting, true, and useful is being formulated in this way. But these methods do not reveal what life is. Nor does the non-mathematical biologist, as a rule, know what life is. He does not seem to know how to distinguish between the many and the one, although the ones which we know best are living organisms. Hence it is impossible for him to distinguish between the non-living and the living. He does not seem to be able to distinguish between the accidental and the essential, and so he cannot distinguish between plants and animals, nor between the brute and man.

These are the real reasons why modern natural science supplies no rational foundation for religion and morality. It is impossible to prove the existence of God by mathematical principles, and modern science contains no other principles, at least no others which are clearly formulated. It is absurd to talk about morality if there is no knowledge of natural agents naturally fitted for and tending to natural goals, and no knowledge of the essential differences of things.

If the salt loses its savor, wherewith will it be salted? The magnificent conception of natural science contained in the works of Aristotle has been misunderstood, caricatured, rejected, and forgotten. Yet Aristotle clearly realized the feasibility of a truly physical science of nature, a science which differs essentially from mathematics and metaphysics, and nevertheless needs to be completed or supplemented by mathematical physics. The physical science of Aristotle contains the principles by which all the natural sciences can be unified in an orderly system and by which the world in all its unity and grandeur can be seen and understood. This is a science not merely of the relations of quantities but of mobile things, that is, of beings which are generated and corrupted and moved or changed naturally, each in its own proper way according to its kind. The motions or

changes of things are manifested to us directly or indirectly, and through our knowledge of these motions or changes we can understand the things themselves and know what they are and what are their properties and relations.

Of course Aristotle realized that we must observe and experience natural things in order to understand them, and that natural science can be developed only from experience. The general principles of this science and the general properties of natural things can easily be discovered from ordinary experience. These are the very truths which modern natural science lacks. On the other hand, the details of natural science cannot be known without special techniques of observation and experiment. These are the things for which modern science is justly celebrated, and for lack of which Aristotle was sorely handicapped and led into various improbable theories. But all the techniques and all the details result only in confusion confounded without the correct first principles and general methodology.

Even among Catholic scholars the Aristotelian conception of natural science is not generally well understood or accepted. There are some who do not distinguish clearly between natural science and metaphysics, although this distinction is basic in the doctrine of Aristotle and St. Thomas. There are others who acknowledge this distinction but maintain that the ancients were mistaken in their unified view of natural science. They wish to divide natural science into a philosophical part which treats of the general aspects of the world and of man and a scientific part which treats of the details in a way which is not philosophical—nor even scientific in the Aristotelian sense. St. Thomas defended the unity of natural science with the remark that we must not be content with knowing things only in general, because the perfection of science consists in knowing the specific details, which, however, cannot be understood except in the light of the general principles. To admit a formal distinction between the science of nature and the philosophy of nature is to rend the seamless robe of natural science, or to raise an iron curtain between the details of modern science and the principles which alone can render them intelligible.

Cardinal Suhard in his "Growth or Decline" strikingly said:

"Your task, therefore, Christian thinkers, is not to follow, but to lead. It is not enough to be disciples; you must become masters. It is not enough to imitate, you must invent. Your research must bear first on pure truth and disinterested science. You must pursue truth for itself, without however, ignoring its applications. You must penetrate more and more deeply the secrets of nature whose enigma is a constant appeal to seek higher, even to God himself. You must integrate the conclusions of your several fields of specialization in order to try and form a cosmic vision of the universe. In this effort you must not involve any consideration of interest, be it even apologetical: you must seek only what is. Your loyalty will only be equalled by your open mindedness and your effective cooperation with all those, believers and unbelievers, who pursue the truth 'with all their soul.' . . . The advance on all fronts will here again have its origin in the efforts of the mind. It will only be possible if research centers, institutes of culture, etc., are established in all fields."

In the crucial field of the natural sciences a generous start at such cooperation is already in progress in the United States under the auspices of the Pontifical Faculty of Philosophy of the Dominican House of Studies, River Forest, Illinois, located in the Chicago area central to vast scientific efforts. For some years the Dominicans of Europe have been concerned about the question, as witness the International Association of Scientific Collaboration which annually holds in Brussels an international gathering of scientists and philosophers.

The American project, however, is of a different type. It is called the Albertus Magnus Lyceum for Natural Science, and aims at initiating not just occasional "meetings of philosophers and scientists" but a work of permanent cooperation among physicists, chemists, biologists, and psychologists, including also members trained in the Aristotelian tradition of science and the liberal arts of scientific method.

One step in securing such a continuous cooperation was effected at a summer school held in 1952. A selected team of men engaged in research or graduate studies in the several fields of natural science lived together during this period at the Dominican House in River Forest. This common residence was an important feature of the plan, since it provided the opportunity for a really dialectical treatment of questions. It is generally recognized that a great barrier to understanding is the lack of "common language" which must be breached by prolonged and patient discussions.

To insure that these discussions dealt with modern science and not with mere opinions about it, the basis for the systematic seminars was furnished by study of a number of typical experiments in the different branches of science and an analysis of the theoretical structures which have been erected upon them.

Besides this major project the Lyceum has also undertaken smaller group discussions with scientists in the Midwestern area, and individual members are at work on special studies concerning the foundations of the sciences. The success of the venture obviously depends upon the willingness of Catholic scientists in particular to make some sacrifice of their specialized interests in behalf of a more thorough analysis of the common basis of all the natural sciences.

A COMPREHENSIVE COURSE IN SOCIAL SCIENCE

Kansas State College

During World War II, Kansas State College, as well as other colleges and universities, examined its program of education in light of the changes which appeared to be imminent at the time. To meet the apparent postwar problems in higher education, an all-college committee on adjustments in postwar education was appointed. One of its numerous subcommittees dealt with comprehensive courses, and after several months of study, it presented a report whose recommendations were considered by the general faculty and eventually adopted with some modifications.

The comprehensive course subcommittee recommended that four general or comprehensive courses be initiated, in the areas of physical science, biological science, the humanities, and social science. Such courses were to be organized to integrate the fields in each area, and to be placed in technical curriculums for purposes of liberalization of the more specialized curriculum. The aim of these courses was to give the student a broad knowledge and understanding of each particular area of knowledge and not furnish him with an epitome of each of the traditional subjects in the area.

When the course in social science was organized, it was soon realized that there was neither a published textbook nor a combination of textbooks which blended the social sciences into an integrated study to serve the purpose of the course. Originally, a mimeographed syllabus was used, primarily to arrange assignments based upon available textbooks and reference material. The rigorous test of experience inspired those who were working in the course to revise, modify, and reorganize extensively, and gradually less and less reliance was placed on published textbook material and more upon an expanded syllabus. Within five years the syllabus underwent four editions, indicating the amount of revision undertaken. It has finally grown into a textbook, written by four members of the social science staff and entitled *Man in Society*. Some idea of the comprehensive nature of the course may be gathered from the chapter headings: Man in Society, Selected Characteristics of Society, the Organization of Society, Controls in Society (Theories, Techniques, Limitations), Social Policy, a World Society.

The following description of the course is taken from the preface of the textbook:

"Although a course of this nature must deal with much the same subject matter material as that in separate social science courses in the traditional curriculums, it is not designed to survey each of the social sciences but rather to present to the student the major principles or trends in society as a whole. In this way, the course does not introduce the student to a single field or segment of an area of study but to all of the fields blended together without regard to the lines of demarcation between the fields. In this respect, the student has an advantage of becoming acquainted with an entire area of knowledge, but under the traditional elective system the average student, particularly the one who may not specialize in the social sciences, would become acquainted with only one, or perhaps two of the parts of an area of knowledge. A course of this type should also enable the student to gain an appreciation of not only the interrelationship of the parts of a field of study but also some understanding of the whole as a unit. For this reason, the course may well serve as a basis for further specialization in the social sciences.

"In the attempt to provide a satisfactory synthesis, little help was obtained from available textbooks because most of these were intended to be used in 'survey' courses in the social sciences. Experts or specialists contributed to such textbooks, and the parts of these textbooks tended to be disconnected, probably because each was written by a specialist without interest or time to synthesize his section into a general overall pattern.

"To achieve a satisfactory synthesis is a most difficult task. Six years of experience and effort have enabled the authors to realize the difficulty, and they do not claim to have discovered a complete solution for this problem. An approach which has been found meaningful to the student is the one presented in this textbook. When the student as a member of society realizes the significant social forces which bear upon him, he can view with better understanding the many causes of social phenomena and the important principles of social relationship. He then can better discern the alternative social values and make an intelligent judgment for himself."

AN EXPERIMENT IN ADULT EDUCATION

Center for the Study Of Liberal Education for Adults

The following material is taken from an article by John S. Diekhoff, Director, Center for the Study of Liberal Education for Adults, Chicago, which appeared in School and Society, August 23, 1952.

During the past academic year the Center for the Study of Liberal Education for Adults sponsored an experiment in adult education in cooperation with member institutions of its parent

organization, the Association of University Evening Colleges. The staff of the center prepared teaching materials for five courses in liberal disciplines — courses specifically designed to meet the needs of adult students as the center staff conceived of them. The titles suggested for the courses (variously modified in different colleges) indicate the subjects with which they deal: (1) Themes and Variations: An Invitation to Literature; (2) Group Living: Its Influence on Attitude and Behavior; (3) Analytical Reading; (4) The American Tradition; (5) Current Issues in International Relations: World Politics. The colleges in the association were invited to test these materials by using them with evening classes of adult students.

When the staff of the center prepared the materials, they were governed by certain criteria for the formulation of courses, *e.g.*,

The materials prepared were not to be guides for the instructor but aids to the student.

Courses were to appeal to adult interests; they were to be prepared for adults, not modified from undergraduate courses.

The reading materials were not to be textbooks but texts — basic documents in the disciplines to be studied.

The guides were to be flexible, allowing instructors to adapt them in the light of their own experience and habits.

The guides were to encourage discussion.

They were to encourage students to think, not tell them what to think.

Student curiosity was to be aimed at; each course should lead beyond itself to further study.

The courses were to assume literacy and maturity, but not academic prerequisites.

The materials were to be inexpensive and easily available.

Some of these "criteria" were among the basic hypotheses which the staff of the center hoped to test in the experiment. Is it desirable to prepare special courses for adult students or will modifications of undergraduate courses do as well? Are "texts" more appropriate than "textbooks" for adult students? Is discussion teaching particularly appropriate for adult students? Is it advisable to provide students with "study and discussion guides" to accompany assigned readings? Can course materials be prepared that will be suggestive to the experienced instructor and helpful to the inexperienced without usurping the prerogatives of the instructor?

There were other questions on which the staff of the center hoped to gain insights: What are the bases of adult interest in particular liberal disciplines? Do adults in different communities respond differently to courses in different disciplines? Are there trustworthy ways of evaluating courses other than the administration of uniform examinations? Is it possible to stimulate curricular study in the colleges by submitting a few courses for their consideration? How valuable is the interchange of experience among institutions undertaking a common task?

The invitation to the colleges to participate in the experiment met with a mixed response. Representatives of 28 of the 86 colleges in the Association of University Evening Colleges expressed interest in participating in the experiment during the spring term of 1952, even though the materials were not available until December, 1951. Thirteen colleges announced the courses, and ten conducted one or more of them. Not all of the college administrators regarded the experiment favorably, however, as they understood it. Some declined the invitation to participate on the ground that the planning and preparation of courses is the prerogative or the duty of the instructor — certainly of the faculty — in each college. That an "outside" agency should have prepared courses for general use was regarded by some deans and directors almost as an infringement of academic freedom, even though the materials were in the form of study guides for students and even though externally prepared textbooks are not regarded as an infringement. Representatives of the center have more than once been told that "no one tells us what or how to teach," both by administrators of evening colleges and by members of the teaching staffs.

The value of the experiment does not depend, of course, upon the response of educators before the courses were tried. It does not even depend upon the quality of the particular courses, certainly not upon their being better than other courses. It does depend upon the ability to answer the questions to which answers were sought. To answer those questions requires some evaluation of the courses.

No attempt has been made at measurement of what students learned in the courses by objective test. Instead, the staff of the center has tried to estimate the degree of satisfaction with which the courses have been regarded by students and instructors who have participated in them.

The experience of those who participated in the courses — faculty and students — does not provide answers to all of the questions the center has asked. There is no basis for judgment about the response of adults in different communities to courses in different liberal subjects and none for judging the appeal of particular subjects to adult students generally. It is too early to judge the fruitfulness of exchange of experience among a number of colleges undertaking a common task. On other questions it is possible to make judgments, with varying certainty.

1. Courses especially prepared for adult students seem to be preferable to adaptations of undergraduate courses.

2. There are occasional complaints about the "difficulty" of assignments and other complaints about their length, but most students and instruc-

tors are agreed that basic texts are preferable to textbooks for adult students.

3. In terms of student satisfaction, and a little less generally in terms of instructor satisfaction, discussion seems to be preferable to lecture teaching for adults.

4. Course materials in the form of a study guide are helpful to adult students, giving focus to their reading and encouraging them to attempt readings which they might otherwise neglect.

5. There is nothing to be said about the relative usefulness of the study guides to experienced and inexperienced instructors. Some observations may be made, however, on the desirability of externally prepared courses. They are resented by some faculty members. Where materials are accepted in the way in which textbooks and anthologies are accepted — as aids, not as directives — they are helpful to both students and staff. There is reason to believe that it is better for an instructor to prepare study guides and similar materials for his own courses, if he has time and inclination and competence to do it. It seems fair to conclude that the center has been successful in devising courses that lead beyond themselves to further study, even when they are taught by instructors who did not prepare them. It is not surprising that enthusiasm for the courses was greatest where they were taught by those who prepared them.

6. On the basis of their experience in interviewing administrators, instructors, and students, members of the staff of the center believe that careful interviews may lead to valid judgments of student and instructor satisfaction.

7. The center's activity in preparing materials for courses and submitting them to the member colleges of the association has stimulated discussion and study of problems of curriculum and method in many of those colleges. Use of the courses and study of the questions they raised induced some instructors to modify their approach to adult teaching. The courses have proved useful in other ways that were not anticipated. A group of alumni of Roosevelt College has used the materials for one of the center's courses, meeting weekly as a discussion group (without an instructor), and another institution is considering establishment of continuing education programs for alumni in a number of urban areas in its state. Another course was used as the basis of discussion classes with a group of convalescents in a Veterans' Hospital.

The most significant testimony to the value of the experiment and of the courses themselves is the fact that each of the colleges which used the materials during the past year intends to use them again and that fifteen other institutions have expressed the hope of using them next year.

SOURCE READINGS:

INTEGRATIVE METHODS AND MATERIALS

The Source Readings department of MAIN CURRENTS is continuing to develop, although contents will necessarily be only partially inclusive until readers have been assigned for all major disciplines and the principal scholarly journals. The number of sources being covered is steadily increasing, however, and the items below comprise some of the more worth while abstracts which have come in from a variety of fields. In these items emphasis has been upon: (1) developments in specialized fields which generate conceptual implications for knowledge in general; (2) discussions of conceptual and philosophic developments within a discipline which will have general implications.

Other criteria which govern the selection of materials for Source Readings are studies in deductive-exact scientific process; and in the relationship of the whole to the particular, which is now seen, in all areas of knowledge, to be indispensable, although the terms vary somewhat from region to region. Successful studies of quanta, general fields, empty spaces, and the continuum are being more and more frequently matched to some extent with new formulations in biology, psychology, and anthropology.

We intend from time to time to provide material which shows concretely the extent to which perennial problems in philosophy are once more making their appearance. In contemporary microphysics, for example, once more the discussion of the plenum and the void are coming forward, notions which engaged the Medieval thinkers and the philosophers of classical antiquity in Rome, Greece, and India.

Mention of new books in the Source Reading Section does not preclude their later review.

METAPHYSICAL TRENDS IN MODERN PATHOLOGY

In the Bulletin of the History of Medicine (26 (1): 71-81. Illus. 1952) Dr. Claudius F. Mayer in an article entitled: "Metaphysical Trends in Modern Pathology," traces the course of research in pathology over the last 200 years since its modern beginning with Morgagni.

"For almost 150 years the interest of the pathologists was focused upon the question, what part of the body carries the disease? With the advancement of our knowledge of the parts in our body, the pathologists continued to shift the site of disease into smaller and smaller units of man's structure. For Morgagni, in 1761, the smallest structural unit was an organ; hence, his was an organ pathology. For Bichat, in 1800, the smallest structural unit was the membrane and tissue; hence, his was a tissue pathology. For Virchow, in 1858, the smallest unit was the cell; hence, his was a cellular pathology. Finally, at the beginning of the 20th century, the anatomical and analytical approach to pathology brought on discontent in the world of the sick as well as among clinicians and practitioners. . . .

"The fourth phase of modern pathology on our ruler begins at 1900. This is the date of birth for the quantum theory of Planck and nuclear physics, and the date of death for classical mechanics. . . . The revolution in physics brought up the idea of wholeness in physical integrated systems, and helped the biological sciences in shaking off the fetters of mechanistic thinking. In general biology, the re-integration of cells, tissues, and organs into an individuum, a living organism, was the merit of Driesch, Haldane, and others. General Smuts (*Holism and Evolution*) named the new approach to life's problems *holism* (from τὸ ὅλον : the whole, the totality).

"Holism is the doctrine that the dynamics of a living whole permits of no differentiation of discrete elements. Its fundamental principle is that an integrated or co-ordinated *whole* is more than just the sum of its constituents. The holistic viewpoint assumes that man is a single, indivisible biological unit and not a socialistic state of autonomous cells as had been taught by Virchow. . . ."

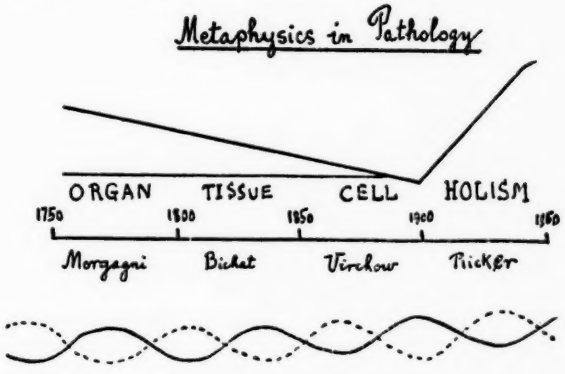
Dr. Mayer next identifies the many varieties of holistic approach in modern pathology, which has received its strongest support among German and other European biologists. He lists the following ten approaches to holistic pathology from 1900:

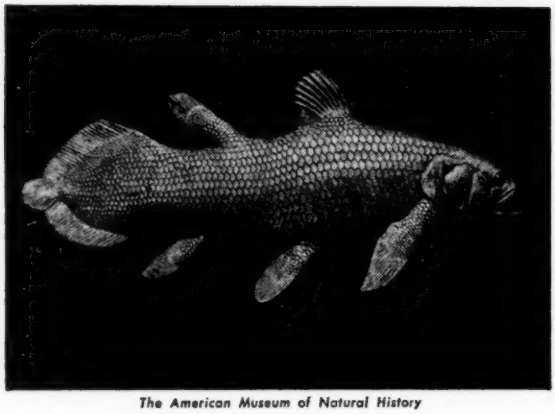
1. Constellation (1920: Tendeloo)
2. Constitution (1914: Martius; 1919: Kraus)
3. Humoralism (1910: Richet)
    a. Chymology (1929: Gallois)
    b. sero-morphology (1927: Löschke)
    c. colloidal (1922: Lumière)
4. Intercellular substance (1943: Chiari)
5. School of Aschoff (1936: Aschoff)
    a. Hetology; Emptomatology (1949: Gräff)
6. Clinical physiopathology (1950: Hoff)
7. Function (1912: Bergmann)
    a. Psycho-somatic medicine
8. Relation (1905: Ricker; Neuro-Humoro-Cellular Trias)
    a. neuro-cellular dualism (1935: Speransky)
9. Dynamic reaction (1946: Neergaard) "Chronoholism"
10. Quantum biology (Pascual Jordan)
    a. Biological medicine (1936: Kötschau)

"The most remarkable are those holistic pathologies which are built upon the nervous system as the chief integrating principle for the coordinated maintenance of the living organism. Gustav Ricker was the first and earliest (1905) with his *pathology of relations* ("*Relationspathologie*") . . . The culmination of holistic ideology is reached in the work of Kurt von Neergaard entitled *Dynamische Reaktionspathologie* (1946). Since for him the word "dynamic" means both functional and historical, he considers time an essential element of disease. . . .

"The holistic approach to pathology and the new principles of scientific research which developed from the anarchy in physics are gradually gaining weight also in North American clinics and laboratories. Pathology of the whole man is coming in place of pathology of the dead parts of man. More and more of us believe that the essential element of disease, regardless of its particular point of attack, is the shock to the existence of the individual caused by the disturbance of the well-regulated functioning of his organism. The physician's goal is then to provide a possibility of existence in spite of disturbance and defect. . . .

"The materialistic point of view of analytical research in pathology brought on disappointment in medicine. The modern trend attempts to reintegrate the individuum, and several metamicroscopical (i.e., metaphysical) theories of disease offer means for such reintegration by synthesis of the accumulated details. The holistic views of Planck, Driesch, Bergmann, Ricker, Speransky, Neergaard, and Wyburn-Mason opened new perspectives for the future development of pathology." — R.P.W.





The American Museum of Natural History

Above is a model of a coelacanth, a specimen of which was acquired in December by Professor J. L. B. Smith, Rhodes University ichthyologist. This prehistoric fish, long thought to be extinct for 75,000,000 years, is the closest living relative to a group of fishes that gave rise to the land-living vertebrates. This discovery will give opportunity for the first time to study the soft organs of this ancient species in comparison with that of modern vertebrates in order to determine more accurately the early pathway of evolution. Soft organs were not preserved in the case of the only other specimen which has been taken. The find was acknowledged to be the most important zoological discovery of this century.

NEW DIMENSIONS OF THE UNIVERSE

It is fitting as well as exhilarating to find that upon the eve of retirement from his post at Harvard, Professor Harlow Shapley was ab'e to offer a further revision of the dimensional study of the universe with which his name is uniquely associated. We take our account from the article by Charles A. Federer, Jr., Harvard College Observatory, in the New York Times, December 31, 1952.

The dimensions of the universe are being revised drastically. The 200-inch telescope can now see two thousand million light-years into space, and the Andromeda galaxy is at least as large as ours. The Milky Way system no longer has the unique and scientifically undesirable characteristic of being the largest galaxy. The universe is expanding at a slower rate, and is twice as old as previously thought.

All this and more changes of far-reaching significance to astronomy and metaphysics result from a revised scale of distance measurements presented by Dr. Harlow Shapley of Harvard College Observatory to the American Astronomical Society December 30.

The results mark the climax of a lifetime of study by Dr. Shapley of the scale of the universe. In 1916 he employed measurements of the distances of the globular clusters to establish the dimensions of the Milky Way system.

He has now crystallized into one distance-scale change the work of many astronomers who in recent years have been indicating with increasing definiteness the need for such a change. He called his results "a note on the revision of the end of the long doubt."

The key to Dr. Shapley's present work is the average brightness of the globular clusters in the large and small Magellanic clouds. These clouds are companion galaxies to the Milky Way, located in the far southern sky and invisible from the United States.

On the average, the globular clusters in the clouds have seemed to be intrinsically three or four times fainter than the globular clusters associated with the Milky Way system. This has been on the basis of a distance to the clouds of somewhat more than 75,000 light-years.

Dr. Shapley proposed that the Magellanic clouds now be "placed" 150,000 light-years away, nearly twice as far as formerly supposed. On this basis, the globulars in the clouds and in the Milky Way have the same average brightnesses.

Such a change involves, however, the scale of intrinsic brightnesses of the pulsating stars known as Cepheid variables, which have long been the yardsticks of the universe.

Distances to the Magellanic clouds, to the great galaxy in Andromeda, and to other near-by galaxies whose individual stars can be seen, have been established by means of their Cepheid variables. Dr. Shapley would now increase their magnitudes on the average nearly four times.

Of course, the observed brightnesses of the Cepheids would remain unchanged, and for any one such star to appear as faint as it does, its distance would have to be doubled. Therefore, every galaxy is twice as far away, and the extremely small, faintest galaxies observable with the 200-inch telescope are two thousand million light-years away instead of half that far.

We can figure backward in time to the moment when the universe began its expansion from a compact "point." The new figures mean that to get to its present size the universe started expanding twice as far in the past, about three or four thousand million years ago.

CONCEPT-LEARNING EXPERIMENTS

Experiments in concept-formation are described by Carl I. Hovland in "A 'Communication Analysis' of Concept Learning," (*Psychological Review*, Vol. 59, No. 6, November, 1952, pp. 461-472).

The material presented to subjects for learning consisted of positive instances (exemplifying the concept in its essential characteristics) and negative instances (exemplifying what the concept is not or does not refer to). Neither type of instances appears to have advantage over the other; the actual effectiveness of each instance depends on the amount of relevant information conveyed by it and on the subject's assimilation of that information.

— *Ralph B. Winn*

SPACE, FIELD, AND ETHER IN CONTEMPORARY PHYSICS

By kind permission of author and publisher, the following passages are selected from a valuable summary of the present position in physics, and especially the physics of the microcosm, in respect to the dynamic role of the properties of empty space in the presence of matter and field. The original is in Science, November 7, 1952, pages 493-496. The paragraphs omitted here are chiefly given to specifying the dimensions, and some of the problems of interaction and of measurement. The material and the course of the argument are not affected for the general reader by these deletions.

"The relationship between matter and space may be expressed by saying that matter occupies space and shapes its geometry. This statement, however obvious and comprehensive it may seem, does not embrace all the properties of space. It holds only for matter in bulk occupying large volumes of space — in short, on the macroscopic plane.

"One of the most important results of quantum field theory, the implications of which have only recently been realized, is that empty space exhibits dynamic properties in the presence of matter and field. This interaction between matter, field, and empty space is of a radically different nature from the static, geometrized effect that matter has on space in accordance with relativity theory.

"The Compton wavelength of the electron, $\frac{h}{mc}$, one of the elementary lengths of physics, signifies the emergence of the dynamic properties of empty space — or the vacuum, as it is called — as well as its creation properties, which exhibit empty space more in a quasi-passive character. Vacuous space is something much more complex than can be described by simple mathematics. Its properties arise because the universe contains matter. Were there no electromagnetic fields or electrons, for instance, there would be no electromagnetic field, electric charge, or current fluctuations in the vacuum. . . .

"The dynamic properties of the vacuous regions of space should be viewed not as belonging to empty space, but as arising out of its interaction with matter and radiation fields. Without interaction this dynamism of empty space is but a formal abstraction lacking physical reality. It is interaction that bestows upon it its substancelike properties. The concept of isolated particle and isolated field existing as absolutes without interaction and with other matter and fields is also but a formal abstraction lacking physical reality (as will be discussed later). This fundamental and unique role of interaction in physical phenomena, however, is nowhere else so clearly brought out as in these vacuum interactions. . . .

". . . as we consider smaller and smaller regions of space, we shall find that electromagnetic phenomena do not exist by themselves but are connected with the occurrences of other types of phenomena. This will involve other matter and radiation fields and the creation of different particles other than electrons and photons. The elementary particles are not absolute; they are all related, and their number may well be legion. It is this large number of elementary particles and their relatedness that introduce a new and undreamt-of complexity into physics.

"It is not unlikely that there are several elementary lengths in physics, each one signifying the emergence of some new phenomenon or the limit of the unambiguous application of some particular physical concepts and laws. . . .

"It is of interest to note that the elementary particles, which are more than a billion times smaller than living cells, have this in common with them. They are both complex, interacting systems that must be considered as wholes. No observation is possible on these elusive fundamental units, living and nonliving, that would reveal the nature of the interaction between their component systems. The difference between the two is that we have succeeded in forming some theoretical conceptions of the interacting systems that constitute the fundamental particle, and we can verify them by their experimental consequences. No such theoretical knowledge of the "self-interactions" of the living cell (those interactions that produce the unity and organization of the cell) is available. It may well be that fundamental advances in this field will not be forthcoming until we gain a better theoretical knowledge that would suggest the decisive experiments necessary for an understanding of the living cell, and that would go hand-in-hand with experiment and observation.

"Pertaining to the importance and function of theory where direct observation is not possible, it is the author's opinion that one of the most important achievements resulting from the recent relativistic covariant formulation of the quantum electrodynamics is the explanation of the Lamb shift and the anomalous magnetic moment of the electron as the *measurable consequences of the unobservable field and charge fluctuations of empty space interacting with the electron. The real in physics encompasses more than the directly observable and measurable.* Interaction and charge are fundamental in nature, and there are interactions besides those that are directly involved in measurement and observation. The self-interactions are an example, and they may have important physical consequences.

"It has been stated that the elementary particle is an open, even complex, system in constant interaction with the vacuum fluctuations of its associated fields. For example, the structure of the electron includes its virtual photon field, and the structure of the nucleon its virtual meson cloud. But elementary physical systems themselves may be related to other elementary physical systems,

as suggested above. The divergence of the higher order terms in the electron self-energy interaction may indicate the necessity of simultaneously taking into consideration the existence of other kinds of particles. Thus there may be a theoretical indication of the relatedness of the elementary particles. There is also experimental evidence suggesting this. Transitions involving decay and collision processes between *V*-particles, nucleons, and π-mesons; π-mesons, μ-mesons, electrons, and neutrinos; neutral π-mesons, γ-rays, and electrons; K-mesons, μ-mesons, electrons; protons, electrons, and photons, show, as was pointed out by Heisenberg, that one elementary particle may be related to another by a series of real and/or intermediate steps.

"All this suggests that in the atomic and nuclear domain the assumption that elementary particles are closed systems may not have an unlimited validity. The great revolutionary finding that contemporary physical theory points to is that the simplicity which has so uniquely characterized physics since its birth needs essential qualifications. The simplicity that will remain as characteristic of physics will be of an aesthetic, symbolic nature, expressed only in the formalism of its mathematics. . . .

"I have stressed the importance of the dynamic or interacting properties of empty space with respect to matter and radiation fields. One may ask, in the spirit of classical physics, whether it is not possible to analyze and isolate these interacting properties with neither matter nor field present. Completely empty space with neither matter nor field present is an idealized condition and can never be actually realized. However, the perfect vacuum — empty space — in the light of the implications of contemporary quantum field theory, is not exactly equivalent to nothing. Because of its dynamic or interacting properties, empty space may be equated to mere activity. For instance, there is the interaction between the electromagnetic field oscillations with the latent electron pairs of the vacuum. But this character of empty space, as discussed previously, can become manifest only by measurements involving wavelengths of the order of $\frac{h}{mc}$. Nevertheless, it may instructive, or at least suggestive, to inquire whether the dynamic character of vacuous space can be carried over in some guise to classical theory and clothed with a classical concept. In the opinion of the author, something of this nature is what seems to have been accomplished by Dirac in his attempts to formulate an adequate classical theory with one eye on the quantum theory and in his ensuing rediscovery of the ether (10, 11).

"Because it is interaction with which we are dealing, one may apply the knowledge gained by quantum mechanics to the interacting properties of the vacuum, or empty space. Quantum mechanics is made possible by the existence of the natural constant of interaction *h*, just as relativity exists because of the natural constant *c*. One could set up a wave function that would describe a state which could not be physically identified, but which represents the vacuum. A wave function of this type is one that would yield all motion or velocity values and directions as equally probable, which is the symmetry property demanded by relativity for the existence of an ether. This ether of Dirac, which is fashioned out of the knowledge gained from quantum mechanics, is not amenable to mechanical description. It may be looked upon as a property of space-time. For this reason, it bears little resemblance to the old-fashioned ether. It may be defined as *hypostatized interaction,* or interaction considered as a thing in itself. It may occur to many that this abstraction is too much, even for contemporary physics. On the other hand, in the light of quantum electrodynamics, an isolated particle or a field is not a closed system, as in the classical definition, but it is constantly interacting with the vacuum fluctuations of its associated fields. The classical concepts of particle and field are as much an abstraction as the concept of isolated interaction. That the concept of interaction has not been treated separately as "action," in the manner of particle and field in the Newtonian and Maxwellian physics, may be a matter of psychology. Isolated particle, field, or action may be legitimately viewed only as theoretical idealizations. In the view presented here, one of the functions of the ether is to give interaction a fundamental role in classical theory that would place it on an equal footing with particle and field.

"It is of interest to note that the properties of the vacuum in Dirac's classical theory are somewhat suggestive of its properties in the quantum domain. His theory involves a velocity field that exists even in empty space. The velocity field, which is a continuum of velocity values, because of its omnipresence will not permit the field quantities to be zero, even — to use Dirac's connotation — in a 'perfect vacuum.' Consequently, it is not surprising that one of the fundamental equations of Dirac's theory giving his potentials in terms of velocity can be fulfilled for a vacuum as well. This equation yields a definite velocity throughout space-time, which may be interpreted as the velocity of an ether. Dirac (12) interprets the ether velocity in the vacuous regions of space as the velocity of a small charge, were it introduced, although the introduction of a charge in the vacuum would violate the conservation of electricity. However, in the equations of his theory, a small charge may be introduced in the guise of initial conditions. And so, even in the classical domain, empty space, because of its ether and velocity properties, and its function as a site for charge creation, exhibits a dynamism somewhat suggestive of its role in quantum theory. Would a final classical theory yielding an adequate quantum theory be as dif-

ferent, conceptually, from present classical electron theories as Dirac's is?

"In any event, one of the significant results of recent investigation in quantum field theory, and even in classical field theory, as just indicated, is the recognition of the complexity behind the ultimately simple. And so a new chapter in physics opens, with overtones suggesting that the simplicity of this fundamental intellectual discipline may reside principally in the aesthetic character of its mathematical elegance."

References

1. Weisskopf, V. *Revs. Modern Phys.*, **21**, 305 (1949).
2. Karplus, R., *et al. Phys. Rev.*, **84**, 597 (1951); Baranger, M. *Ibid.*, 866.
3. Dyson, F. J. *Ibid.*, **85**, 631 (1952).
4. Van Hove, L. *Physica*, **18**, 145 (1952).
5. Stern, A. W. *Physics Today*, **2**, 21 (1949).
6. Schiff, L. I. *Phys. Rev.* **84**, 1 (1951)
7. Dirac, P. A. M. *Nuovo cimento*, **7**, 925 (1950)
8. ———. *Proc. Roy Soc.* (*London*), A, **209**, 291 (1951).
9. ———. *Ibid.*, A. **212**, 330 (1952).
10. ———. *Nature*, **168**, 906 (1951).
11. Infeld, L. *Ibid.*, **169**, 702 (1952); Dirac, P. A. M. *Ibid.*
12. Dirac, P. A. M. *Ibid.*, 146.

REVIEWS

The thesis of *The Taming of the Nations* by F. S. C. Northrop (Macmillan, New York, 1952, $5.00, 336 pp., notes and index) is that a free world foreign policy, international law, and the United Nations, must recognize the plurality of the living law cultures which are herein enumerated: the South Asian, the European, the British Commonwealth, the American, and the Latin-American. The chief cultural root of each of these groups is identified, and the present overriding superior force of the given culture is shown to be currently putting nationalism in its place.

The volume is thus a continuation of Northrop's previous books; his penetrating thought, and marshalled evidence should establish it as a political handbook for state departments. The present reviewer espouses the general thesis of this admirable book, but is eager to have the author discuss two important matters he has thus far neglected.

Economic developments which have led to cartels and other concentrates of power get very little attention, and no systematic treatment. We have to find out what is happening to the economic and political power created by the inventive American, so rightly recognized by Northrop as trading with nature to produce with such talent. Do the policy and the philosophy of the great concentrates of American finance coincide with our cultural genius generally? By this we mean to ask not whether the individual men who operate finance are moral and ethical persons, conforming in their personal lives to the American cultural genius, nor whether General Motors has an enlightened labor policy, also suited to the American response to natural law. The first substantive words of *The Taming of the Nations* are "open diplomacy openly arrived at." Finance is now a part of diplomacy. How do we determine its cultural standards? Does it, like real science, know no boundaries whatsoever and belong therefore to no one cultural system? If so, are its referents natural moral law, or what?

We would also prize from Northrop a work as simple as his *Logic of the Sciences and the Humanities*, and as sweeping and true and precise as his *The Meeting of East and West*, but directed to this question: What should be the content and the methods of an education that would identify what is common to the several living law cultural groups which he enumerates? Insofar as we are the children of nature, and citizens of a cosmos, all men must have many cultural features in common. Simply put: What do we do, in terms of education year by year, to teach a universal natural-moral law?

The present volume provides a prescription for a political compromise. It quite convinces this reader that police action must rest upon an admission of plural cultural norms, but this is not enough as the basis for a world society. We hope we shall have presently from Northrop a discourse on the nature of man on the *anima mundi*, to provide a common constructive source for the laws of a world society. — F.L.K.

We have had a generation during which it has been the vogue to see one's analyst, who, by probing the "depths" of the psyche, has been presumed to enable one to rise again to face "reality" and to become an "adjusted" personality. This generation, too, has witnessed such an increase in preoccupation with "adjustment" that it has become the *sine qua non* of the good life. Any teacher worth her salt has been required to be as interested in the "adjustment" of her pupils as she has been in teaching them anything. By the same token, every mother worthy of reverence on the second Sunday each May has probably worried more over her child's "maladjustment" than she has over his malnutrition. This has been a manifestation of the levelling off process by which security has been the goal and by which culture has become presumptively standardized. Strangely enough, this has also been the generation which has produced more symptoms of individual and mass neurosis, greater insecurity on subjective levels, and more lawlessness in spite of more laws than any other.

Now come Frederick S. Perls, Ralph F. Hefferline, and Paul Goodman, all Ph. D.'s and the first an M. D., with a book, *Gestalt Therapy—Excitement and Growth in the Human Personality* (New York, 1951, The Julian Press, Inc., $6.50) to suggest that it is society which is neurotic and not we; that "reality" as stereotyped in iron-clad mores is not necessarily reality at all; and that "adjustment" not only removes much of the excitement inherent in life but tends to stunt the growth of personality.

It is encouraging to discover increasing signs of a return to a dynamic point of view regarding human personality.

Recognizing that "the average person, having been raised in an atmosphere full of splits, has lost his wholeness, his integrity," the authors believe "that the gestalt outlook is the original, undistorted, natural

approach to life . . ." They point out that we have become accustomed to thinking in dualisms and contrasts "of infantile and mature, of body and mind, organism and environment, self and reality, as if they were opposing entities."

Freudian psychoanalysis and other systems are here appraised, and a comprehensive theory is developed by which "we [the authors] had to shift the concern of psychiatry from the fetish of the unknown, from the adoration of the 'unconscious,' to the problems and phenomenology of awareness . . . [for] awareness is characterized by *contact,* by *sensing,* by *excitement,* and by gestalt formation." And here arises the second phase of the subtitle, growth: "Any incomplete gestalt represents an 'unfinished situation' that clamors for attention and interferes with the formation of any novel, vital gestalt. Instead of growth and development we then find stagnation and regression."

The subjective-objective dichotomy, the proprioceptive senses and the aware contacting of the environment are examined. The techniques of commonly-accepted psychotherapy are appraised and the deficiencies in modern society which contribute so largely to the stereotype of the average "adjusted" person's life are brought into new light: Witness the chapter on maturing and infantilism and that on "the anthropology of neurosis" ("it is the more respectable functions of orientation and manipulation in the world, especially the social world, that are out of kilter and cannot work").

If no other contribution has been made than that of urging the reader to view himself not only *in action* but *as action,* this book should do much to stimulate and encourage others to continue to seek the nature of human nature in the light of dynamic and holistic concepts.

In *Religious Values in Education,* Ward Madden (Harpers, 1952, 191 pages, bibliography and index, $3) describes a lamentable and well known state of affairs (p. ix, x, xi): ". . . the great majority of students [in his college] are confused, dissatisfied, and groping. I believe these students are representative of the mentality of our age. They are the older, more mature students in this public college, located in one of the great centers of Western culture. They have grown up in a society oriented to the Judaic-Christian tradition. Their parents, much less educated for the most part than they, accepted the old traditions without much criticism.

"The old forms of religious belief and practice had an almost unchallenged impact upon these students as children during their formative and impressionable years. But as they reached the high schools and particularly the college, they were subjected to an increasingly intensified barrage of scientific and humanistic ideas and facts which influenced their whole outlook. Today, at the end of sixteen or more years of schooling, they find themselves bewildered and searching for a reasonable faith. I suspect they share this state of uncertainty with many of their elders of equivalent education.

"Not education, but the state of Western civilization itself, has brought this to pass. The scientific world view has made the authoritarian dogmas of supernatural religion unacceptable to the contemporary mind. Yet the new outlook has failed to satisfy our spiritual needs . . ."

"The real problem is to find a religious outlook suitable to the modern temper. This outlook, when it emerges, must come from the common life of the people. This book does not presume to predict what the new outlook will be. It rather suggests how education can help people find religious quality in their common experience."

This is a modest program, and Dr. Madden's examination of the religions serves well as immediate practical guidance for teachers, looking toward further evolution of modern scientific theory into a needed cosmology and a view of man. The modes are the valuational, the community, the executive, the aesthetic, and the contemplative. Each is examined, and then treated in terms of education, "the creative social act."

To a considerable list of books on educational practice, A. Gordon Melvin, Professor of Education, College of the City of New York, now adds *General Methods of Teaching* (McGraw-Hill, 1952, 243 pages and index, $3.75). A mature and sensitive teacher of teachers provides here a quiet, simple, and thorough account of the years of practice and wide observation which he has accumulated. Each chapter concludes with a select bibliography of books, and in one case of films. The chapters are: The teacher's task; doing brings learning; the values the teacher hopes to pass to new lives; forecasting the class program; meet the players; peace and order; content of teaching and meaning; method and technique; group and individual development; mounting the lesson; the social meaning of teaching; checking up.

In *The New Physics* (Philosophical Library, New York, 1951, 141 pages and index, $3.75) Sir C. V. Raman brings together nineteen non-technical brief radio talks on physics. They skirt and dress a central thought, the orders of nature, and make easy reading, but the material and treatment is so near the surface of fact and episode as to offer very little knowledge of system and method to the adult reader of general science.

Books Received for Review

Ideas and Men, The Story of Western Thought, by Crane Brinton, Prentice-Hall, New York, 1950.

Our Common Neurosis, Notes on a Group Experiment, by Charles B. Thompson, M.D., and Alfreda P. Sill, Exposition Press, New York, 1952.

Moral Principles of Action, planned and edited by Ruth Nanda Anshen, Harpers, New York, 1952.

Moral and Spiritual Values in Education, by William Clayton Bower, University of Kentucky Press, Lexington, 1952.

Creative Education in the Humanities, by Arnold Didier Graeffe; Harpers, New York, 1951.

Elementary Science Education in American Public Schools, by Harrington Wells, McGraw-Hill, New York, 1951.

The Humanities at Scripps College, Ward Ritchie Press, Los Angeles, 1952.

General Education in School and College, a committee report by members of the faculties of Andover, Exeter, Lawrenceville, Harvard, Princeton, and Yale, Harvard University Press, Cambridge, 1952.

A History of Science, by George Sarton, Harvard University Press, Cambridge, 1952.

NEWS AND NOTES

The first article in this issue of MAIN CURRENTS is intended to assist friends of the Foundation to make the social meaning of its program more and more widely known. Several associates have kindly worked out this simplified exposition. For this reason it is unsigned. It is not intended as an official pronouncement, but is merely an attempt to put clearly, and without emotion, something which, nevertheless, should prompt by its significance deep stirring of hope.

It is surely likely to do so, if one believes in democracy, if one holds that freedom is a function of order, and if one concedes that only an education which will communicate knowledge of natural-moral order in proper range and depth can validate the freedom which we Americans ideally proclaim. The Constitution embodies this ideal, but the educational system must document it. One of the basic orders which the founders wrote into the Constitution was that executive, legislative, and juridic functions are different, and that the legislative branch (for example) is not to destroy courts by usurpation of their functions. This orderly triple functioning of our society is but one expression of the conviction of the founders that there are natural-moral laws which alone ensure freedom. We now have a society and a science so complex that education is no longer able to teach with one united voice, as a consensus, the system of natural-moral law with any proper degree of adequacy. Fundamentally is it not this failure which is causing the breakdown of our society?

Reprints of this article, "The Social Meaning of the Foundation for Integrated Education," are available, without charge. Merely write for them, if you please. It is important, surely, for educators and laymen to unite upon some mid-level of expression of the difficult program which embodies hopes they hold dear, and hold in common. By this means they can take action together, at the most basic level, "to secure these rights." We shall also be glad to mail this statement directly, if postage be supplied, to anyone whose name and address are sent to us for this purpose.

There is no royal road to integration. If the requirements of this complex process are stated simply, they sound like platitudes. If more technical language is used, the general reader is ill-served, and the specialist may interpret the terms narrowly. If the program is described simply, and every point is illustrated, both parties may follow the reasoning but it would take a volume to make even a fair start.

Nevertheless, slowly the method and the possibilities for systematization of the whole of knowledge are becoming more and more clear and the contributions of qualified scholars come in to MAIN CURRENTS from diverse fields, each reflecting the new light. In this issue the reader will notice that examples of the profoundest problems in physics, sociology, economics, philosophy, education, world affairs — a whole spectrum of interests — receive treatment in terms summed up in a single word: integration.

It is clear that this structuring has to occur on the frontier of knowledge, and so the magazine at the same time functions as a sort of news agency.

In this issue we print a closely reasoned exposition of the principles of social measure which Dr. Stuart Dodd has so admirably refined. This, with the article on modern physics and economics by Dr. Charles B. Friday, concludes the reports of those proceedings of the Foundation's Sixth Summer Workshop (at Oregon State College, June, 1952) which are to appear in MAIN CURRENTS.

Reprints of Dr. Dodd's compact and precise definition of the principles of measurement science, applied to social phenomena, often called social physics, will also be made widely available in reprint form.

To colleges and universities affiliated with the Foundation's Cooperative Program, reasonable quantities will be supplied without extra charge. To teachers of social studies and others who may find it useful for class reading, a small price will be fixed, 25¢ each, in lots of ten copies. This exposition will also be included in the special source reading which is being supplied for the courses of study which the Foundation is currently conducting.

The Council of the Foundation for Integrated Education has been strengthened by the addition to it of Mr. H. E. Emmons, of Tacoma, Washington. Mr. Emmons has been a constant advocate of the Foundation's policy and a staunch supporter of the program. His willingness to serve as a Councillor is much appreciated.

Dr. Ruth Lofgren has consented to act as Research Associate in biology. Miss Lofgren is on the faculty of the University of Michigan, and will act in her special field of science (as Mr. Robert P. Whorf functions in respect to mathematics and physics) as an advisor on practical measures, especially those calculated to increase the authority, coverage, and coordination of source reading.

A short lecture sequence which promises to be of substantial and lasting value for orientation to integration will be offered at Cold Spring, New York, by the Foundation for Integrated Education, by invitation of the co-sponsor, the Walt Foundation. The series is expressly devised for the resident students of the Cold Spring Project in adult education, Dr. Ruth Andrus, Director, and Mrs. William S. Ladd, President. It will, however, generously be thrown open by the Walt Foundation to residents in nearby communities, including faculty in Vassar College.

The course will be carried by men drawn from among the lecturers in the Foundation's current series at New York University and in Philadelphia, and is as follows:

February 13—"The Need for Integration," by F. L. Kunz, Executive Officer, Foundation for Integrated Education.

February 20—"Evolution of Social Forms in Terms of Society," M. F. Ashley Montagu, Department of Anthropology, Rutgers University.

February 27—"Evolution of Scientific and Philosophical Thought," Henry Margenau, Higgins Professor of Physics and Natural Philosophy, Yale University.

March 6 —"The Historical Development of Three Psychologies of Education," Mark A. May, Director, Institute of Human Relations, Yale University.

March 13 — "World Wealth and World Settlement," Kirtley F. Mather, Department of Geology, Harvard University.

March 20 —"A Challenge of the New: Summary of the Program of Integration of Science and Culture," F. L. Kunz.

At the New York University course, "The Frontier of Knowledge," last year and this, students have had the advantage of a seminar each week conducted by a member of the New York University faculty. Weekly seminars of this nature have not been possible in the Philadelphia course, and discussion has been confined to the half or three-quarters of an hour allotted to it after each lecture. In order that the maximum advantage and the fullest possible integration of the course material may be available to the students, the Foundation and the Philadelphia committee have set aside three additional evenings without cost which will be devoted to two-hour seminar-discussions.

The first of these will be held on January 28th, at which time the first term of the course will be discussed. The second will be held on April 8th to discuss materials contained in the first nine lectures of the second term, and the third will be on May 27th to integrate the last six lectures of the second term and review the full year's work.

In preparation for the first seminar, conceptual materials and demonstrations have been abstracted from the lectures of the first term. These have been organized under four headings: (1) historical instances of conceptualizing; (2) the methodology and philosophy of science; (3) the development and demonstration of specific modern concepts; (4) general outworkings and implications. These will be mimeographed and given to the students in advance of the seminar as a summary of the work of the first term. The students will be asked to discuss these materials in the light of their integrative effects. The Foundation feels that this is a significant development in the operational procedure for its course, "The Frontier of Knowledge," and will share its results with members of the Cooperative Program.

The first page of Vol. 1, No. 2 of the *Journal of Human Relations* is devoted to basic ideas of the Foundation for Integrated Education.

STATEMENT OF OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946.

Of MAIN CURRENTS in Modern Thought published Quarterly at Port Chester for October 1st, 1952. State of New York, County of Westchester. Before me, a Notary Public in and for the State and county aforesaid, personally appeared F. L. Kunz, who, having been duly sworn according to law, deposes and says that he is the editor, publisher and owner of the quarterly MAIN CURRENTS in Modern Thought and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily, weekly, semiweekly or triweekly newspaper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946 (section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit

1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, F. L. Kunz, Port Chester, New York; Editor, F. L. Kunz, Port Chester, New York; Managing Editor, None; Business Manager, None. 2. That the owner is (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) F. L. Kunz, Port Chester, New York. 3. That the known bondholders, mortgages, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None. 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him. (Signed) F. L. Kunz.

Sworn to and subscribed before me this 30th day of September, 1952. Mary E. Hoey, Notary Public, State of New York, No. 60-181500, qualified in Westchester County (Commission expires March 30, 1953).